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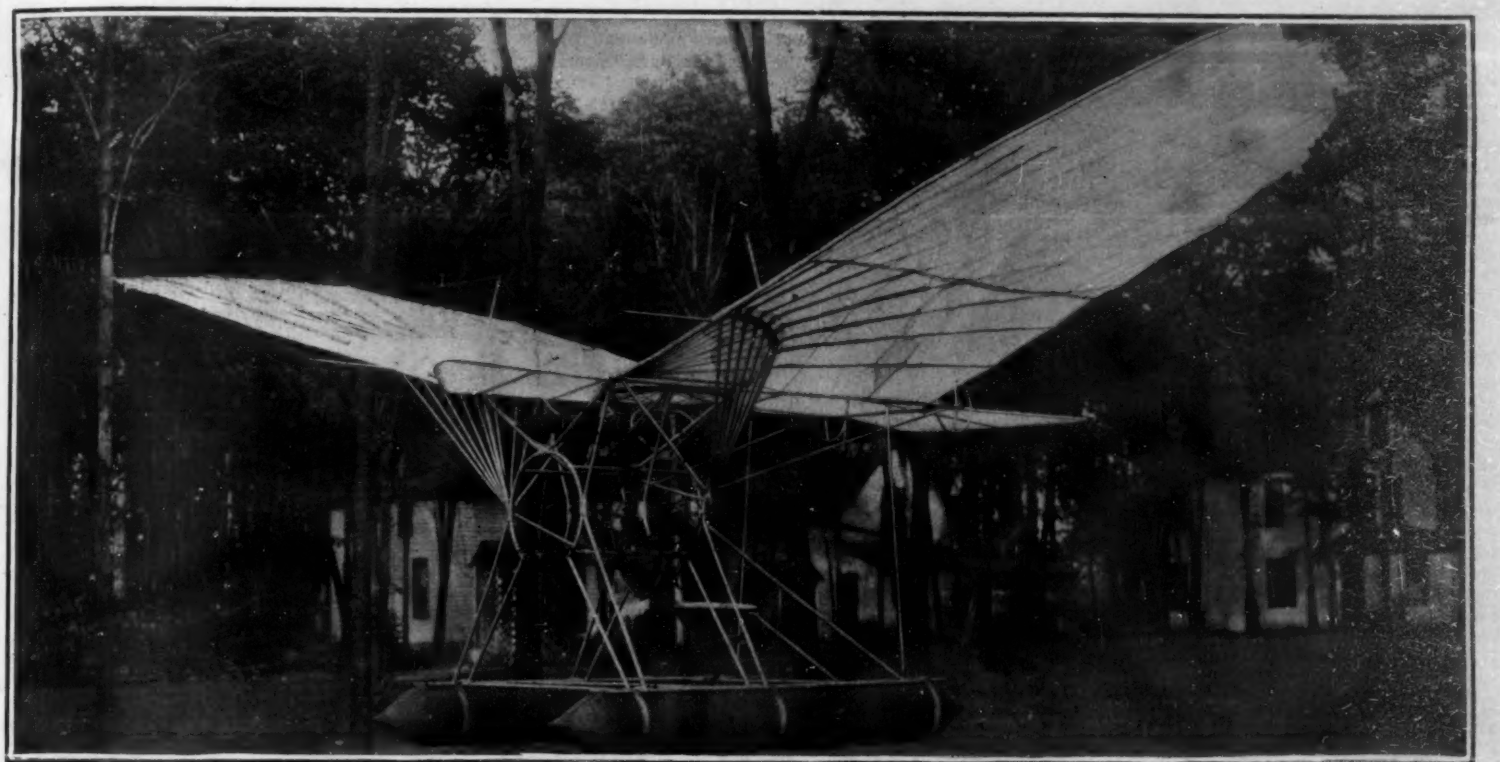
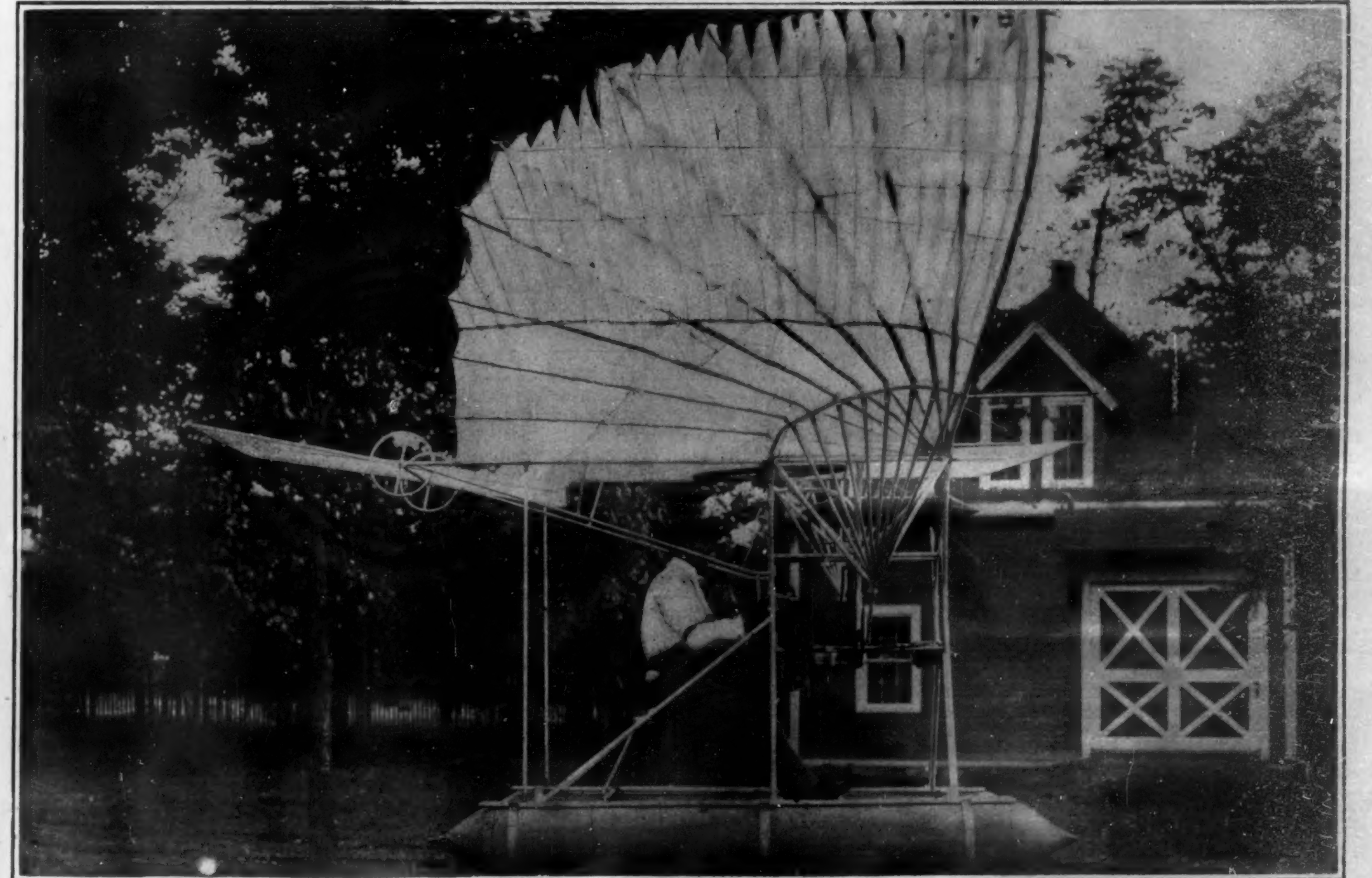


The Gammeter Orthopter. Width, 30 Feet from Tip to Tip; Length, Including Rudder, 12 Feet; Area of Body, Including Rudder, 48 Square Feet; Area of Wings, 154 Square Feet; Total Area, 202 Square Feet.



Side View of the Gammeter Orthopter. Weight, 490 Pounds With Operator and Fuel; Engine Rated at 7 Horse-Power; Speed of Engine, 1,200 Revolutions Per Minute; Speed of Wings, 75 Vibrations Per Minute.

A NEW BEATING-WING FLYING MACHINE, A COMPETITOR FOR THE SCIENTIFIC AMERICAN TROPHY.—[See page 258.]

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NEW YORK, SATURDAY, OCTOBER 12, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A SWEDISH CHALLENGE FOR THE CUP.

At the present writing it looks as though the New York Yacht Club would, in the near future, be confronted with a challenge for a series of races for the "America's" cup from Sweden, a request having been received through the Royal Swedish Yacht Club for full details regarding the conditions which would govern such a contest. Upon the receipt of this information it is probable that a challenge will be sent for a series of races in the year 1909. As far as one may judge from cable dispatches, the proposal has been received with widespread approval in the land of the Vikings, and, indeed, should the event come off, is likely to take on even more of a national character than have some of the recent British attempts to secure the much-coveted trophy. This is so far true that the two yachtsmen who are the moving spirits in the matter, propose, after themselves providing the major part of the price of the yacht, to throw the matter open for general subscription. Novel, if not fantastic, as such a plan might seem to be, it is actually only an extension of the syndicate method, by which the heavy cost of building and racing of our later cup defenders has been distributed.

Now that Sir Thomas Lipton has disavowed any intention of further prosecuting his plans for a fourth challenge for the cup, it must be admitted that there is something very attractive in the idea of seeing a Swedish yacht, designed and built in Sweden, and manned by the far-famous Swedish sailors, competing over the classic Sandy Hook course for the world-famous trophy. Historically Sweden may justly claim to be connected, if not with the cup, at least with the famous schooner which originally won it; for in 1852, the year following the "America's" success at the Isle of Wight, the Swedes who, at that time, were turning out some of the fastest schooners in Europe, built a large schooner which they named the "Sverege," and challenged the "America" to sail a race from Ryde pier to a point 20 miles to leeward of the Nab Light and return, the wind to be of a strength of at least 7 knots at the start. The "America" was then owned by Lord John de Blanquiére, who had purchased her from Commodore Stevens for the sum of $25,000. The Swedish yacht builders had for some time been constructing their boats on somewhat similar lines to those of the "America"; but the "Sverege" was a much larger craft, measuring 280 tons against the "America's" 208. The "Sverege" led the "America" around the outer mark by 8 minutes and 26 seconds; but in rounding she carried away the jaws of her main gaff and the spar had to be nursed somewhat in the beat home against the wind. According to the historian, the Swedish vessel ran into thick weather and overstood the mark by 20 minutes, finishing, however, 26 minutes behind the "America," whose superior sailing with sheets aboard, won the race.

Although in the intervening fifty years Sweden has never been represented by a challenger for the cup, she has been most intimately connected with its defense through her unrivaled sailors, who in late years have constituted the major part of the crews on the defending yachts. If the proposed race should come off, it is probable that we shall have to fall back upon the men from Deer Island, from among whom in previous years Capt. Hank Haff and other American skippers were wont to select their racing crews. The Royal Swedish Yacht Club is a very influential organization with something like two thousand members and a register of over six hundred yachts, of which only comparatively few are steamers. Swedish yachtsmen are second to none in skill and enthusiasm, and although they have had no experience in the construction of extreme racing machines such as have been evolved by the "America" cup contests, there is no reason to doubt that they will send to Sandy Hook a yacht so well built and ably manned that an excellent series of races will be assured.

AMBITIOUS SCHEME OF ELECTRIFICATION.

What is unquestionably the most important project of electrification of a steam railroad under consideration in any part of the world, is that recently announced by the Southern Pacific Railroad Company through one of its vice-presidents, who has requested Mr. Sprague, the father of the multiple-unit system of electric operation, to study the question of electrifying the Sacramento Division of the Southern Pacific system which extends for a distance of 136 miles from Rockland to Sparks. For some years Mr. Babcock, the electrical engineer of the Harriman lines, in company with the engineers of the leading electrical manufacturing companies, has been making a special study of this project; and the joint report of these gentlemen and Mr. Sprague will be the subject of final action by the directors.

The magnitude of the problem will be understood when it is remembered that the other two important electrifications of steam railroads, those of the New York Central and the New Haven lines, cover, in the one case, a stretch of 34 miles, with a branch of 15 miles, and in the other case of 22 miles. It is a far cry from this to the electrification of a road approximately equal in length to the road from New York to Albany; and the difficulties of the Southern Pacific problem are further increased by the fact that the work must be done on a mountain division, over which is carried the entire freight and passenger traffic of the Union Pacific system between Central California and the East. Moreover, in a distance of 83 miles the line rises nearly 7,000 feet, and the road is single-track, full of the characteristic sharp grades of the western mountain summit division, and includes over 31 miles of tunnels and snowsheds. Although there is a heavy traffic, it is intermittent; and the difficulty of keeping open an electric service in the winter is complicated by the fact that the snows will often drift to a depth of 15 and 20 feet. Although this division is worked by powerful modern locomotives it is found to be difficult at times to maintain the traffic, which is occasionally congested to the point of an absolute blockade. However, since this mountain forms, as it were, the neck of the bottle on one of the most important of the transcontinental lines, it is realized by the directorate that a point has been reached when some radical change must be made to secure an increased capacity for traffic. Of the alternatives presented, there is first, that of paralleling the present track, which would be an exceedingly difficult and costly work; second, the location of an entirely new line with easier grades and the reduction of the summit level by the construction of a great tunnel through the mountain; or thirdly, a change of motive power from steam to electricity. The question to be decided is not as to whether it is feasible to operate this 136 miles of mountain road electrically—there is no doubt whatever on that point. The final decision of the directors will be determined by the questions, first, as to whether the present and probable future traffic will warrant the enormous outlay which will be necessary, and secondly, as to whether the change to electric traction would provide an increase of capacity larger than could be secured by any other method

OUR STUPENDOUS RAILROAD SYSTEM.

The railroad system of the United States outranks in mileage and business all the other railroads of the world in much the same way as the shipping industry of Great Britain overtops that of every other maritime nation; and if we were asked to indicate that special sphere of industrial activity in which this country has achieved its most marked and individual success we would select our wonderful system of railroads. The latest statistics for the year 1906, as given in Poor's Manual, show that the rate of growth is steadily maintained therein, reflecting the widespread prosperity which the country is now enjoying.

The total number of miles of railroad under operation is 220,633, an increase of 5,000 miles in the year, and on these roads there were carried over 815 million passengers and 1,610 million tons of freight, the corresponding earnings being on passenger traffic 520 million dollars and on freight traffic 1,650 million dollars. Adding to these totals other sources of revenue we reach a total of gross traffic earnings for the past year of 2,347 milllion dollars, and the net earnings on this business amounted to 790 million dollars. Adding other receipts, a total available revenue was shown of 890 million dollars. This represents an increase in 1906 over 1905 of over 234 million dollars, or more than 11 per cent.

The operation of the system called for the service of 55,439 locomotives, 83,896 passenger cars, 12,295 baggage and mail cars, etc., and 1,979,667 freight cars, making a total of over two million revenue-earning cars. Equally large are the figures representing the financial liabilities. The capital stock amounting to over 7,106 million dollars, the bonded debt is 7,851 million dollars, and other liabilities bringing up the total to the enormous sum of 17,534 million dollars. Of the assets 12,719 million dollars represent the cost of the railroads and equipment, and 2,544 million dollars in stocks and bonds owned.

It is of considerable interest to trace the growth of the system by decades. Thus, in 1881, there were 130,455 miles of track, about 20,000 locomotives, and 667,218 cars. In 1891 there were 214,529 miles of track, 33,563 locomotives and 1,194,130 cars. In 1901, the track mileage had risen to 266,000 on which there were at work about 40,000 locomotives, and 1,445,283 cars, while in 1906 the total miles of track, the track in these figures representing actual mileage of single track, 307,000 miles, with, as we have seen above, 55,439 locomotives and over two million cars.

In view of the present anti-railroad movement in this country and the hostile spirit which is undoubtedly manifesting itself with increasing emphasis, it is notable that the average interest rate on railroad bonds during 1906 was 3.99 per cent, and the average dividend rate on all railroad stock was 3.63 per cent. These low average rates of capital invested in the railroad are highly instructive as bearing on the question of the reasonableness of railroad rates in this country.

THE FORMULA AND THE TESTING MACHINE.

The Quebec Bridge was the victim of a too blind faith in the formula. This primarily. Possibly it was the victim of the unwise practice of permitting the successful contractor for a bridge to work out the details of the design himself. We understand that the contract for this bridge was taken for a fixed sum. If so, this obviously imposed upon the engineer who developed the plans, the task of keeping down the sum total of material in the bridge to the lowest possible figure compatible with safety. The obvious way to reduce the total weight was to use a high unit of stress, and in the Quebec Bridge, and particularly in the compression member which failed, a unit stress was used which, to put it mildly, simply staggered the engineering world when the strain sheet of this bridge was made public. And yet, it is a fact that even with the high unit stress employed, if the formula used in calculating the compression members had been as reliable in these abnormally large sections as it had proved to be in smaller sections, the bridge should not have gone down, even when completed and loaded; and certainly it should not have fallen when loaded as it was at the time of the collapse, with only one-half of the calculated maximum load which might be imposed when the bridge was in operation.

Among the many lessons taught by this catastrophe, the one which stands out pre-eminently is that some of our bridge engineers have been placing an altogether too implicit faith in the commonly accepted formula for compression members, and also that they have been too anxious to practise economy of materials. In proof of this we direct attention to the comparative sections on another page, drawn to the same scale, of the chord member of the Quebec Bridge and that of the Forth Bridge. The strain sheets of the Forth Bridge have never been published, but presumably the load on the corresponding members in the two bridges was about the same. If so, one or other of the two engineers responsible for these designs was wofully in the wrong. Either Baker's enormous and rigid tubes are absurdly big, heavy, and costly, or the curious assemblage of flexible plates in the Quebec Bridge member is ridiculously light and inadequate. A prominent engineer, since connected with the Quebec design, some sixteen years ago stated that an American engineer could have taken the money subscribed for the Forth Bridge, and after building the structure have turned back fifty per cent to the owners, instead of having to collect, as was done, forty per cent in excess of the estimate. We have now seen the experiment made with a cantilever bridge of slightly larger dimensions; and the result of the attempt to build such a structure by the more economical method of using flat plates, pin connections, and high unit stresses, is shown in the 17,000 tons of steel junk which now encumbers the bed of the St. Lawrence River.

And yet, in all fairness it must be admitted that, according to the formula used for the compression members, they should easily have stood up under the load under which they collapsed. Some modification of the formula for built-up rectangular compression members is evidently necessary, when it is applied to such large sizes as those in the Quebec Bridge; and we think it cannot be disputed that the only satisfactory way to determine the actual strength of the largest rectangular columns of the character almost universally used in American bridge practice, is to put up a testing plant sufficiently powerful to make the required tests.

Does it not look as though the time has arrived

when, in view of the enormous interests involved, Congress should appropriate funds for the institution of such a plant, in which tests, even as costly as these, could be carried out? The testing of large-sized bridge members would form only a part of the work which such a plant would accomplish. The rapid development of concrete construction, for instance, has brought in its train a number of problems which call for immediate investigation. Evidence of this is afforded by the many failures of armored concrete which are continually occurring. It is positively appalling to think of the number of buildings, factory chimneys, bridges, etc., which are being rushed up all over the country, and contemplate the fact that no small percentage of them embody inherent weakness either of design or construction, which may bring about their ultimate collapse. In the field of concrete-steel alone, a government plant of this kind would yield invaluable results. It is true that the government is doing, and has done, a large amount of work of this character in plants of limited capacity, but the plan we advocate would call for a thoroughly comprehensive, well-equipped plant, presided over by a corps of civil engineers, permanently assigned to their positions, who would thus acquire that store of cumulative knowledge and proficiency which continued service in a special line such as this can alone insure.

HOW TO PREVENT FAILURE IN CONCRETE CONSTRUCTION.

The many failures which have recently occurred in concrete constructions emphasize the necessity for a revision of some of the current methods of design and erection, and the formulation and strict enforcement of building laws of a thoroughly searching character. As we have frequently pointed out in these columns, there is no material of construction that offers such inducements to cheap and fraudulent work on the part of the unscrupulous contractor as armored concrete. As throwing a great deal of much-needed light on this subject, we direct attention to a voluminous paper read before the Western Society of Engineers by Dr. W. Michaelis, Jr., and published in the current issue of the SUPPLEMENT. The author of the paper deals at great length with the merits and limitations of cement and concrete and the causes of failure in concrete construction, and suggests means for the prevention of such failure. While, on the one hand, manufacturers exaggerate the advantages of cement, on the other hand the engineer and architect make unreasonable demands, and misinterpret the failures in concrete construction that so often occur. The best way to establish confidence in this modern building material would be to minimize the danger of failure by establishing proper building ordinances, which would compel the contractor to handle the material in the prescribed way, and to make proper tests of it while the building is in course of construction. The principles governing modern concrete construction are thoroughly understood, according to the author of the paper, by comparatively few; and this explains the divergence of opinion on many points pertaining to this branch of the building industry. While some engineers are careful to specify concrete of ample strength, others blame such "over-cautious" builders for making use of an excessive factor of safety. In reply to the statement frequently made by engineers that cement is not sufficiently uniform at present, and that if it could be so manufactured as to give as uniform results as steel, it would be possible for the engineer to reduce the larger factor of safety now demanded for concrete over that required for steel, the author of the paper answers that such a statement is entirely without foundation. Steel is a well-defined chemical compound rolled into the desired shape, while concrete is the sum of a number of factors. The calculation of a steel girder and that of a reinforced concrete girder can never be based on equal safety factors, no matter how much the properties of cement may be improved in the future; and it will not be improved in the future for the reason that we have arrived at the limits of its good qualities. In the opinion of Dr. Michaelis, the author of the paper, failures of concrete steel can be materially lessened, if not entirely prevented, by making it compulsory to use concrete of specified proportion of crushed stone, sand, and cement, and to use the proper kind of reinforcement in each case, and the necessary amount of it. Certain standard rules should be laid down by a Board of Building Examiners, and certain types of reinforcing material should be excluded where they are not in their proper place. Moreover, the erection of the building should be accompanied by continuous tests of the concrete that goes into the construction, and the builder should be compelled to inform himself of the strength of each column, girder, beam and floor slab before striking the forms and placing the load upon them.

THE ELECTRICAL SHOW AT MADISON SQUARE GARDEN.

The exhibitions of electrical devices and apparatus held each year at Madison Square Garden afford the public an excellent opportunity to study the progress of electricity in various branches of its development. To be sure, exhibitions of this sort are not intended for the purely technical man, and as a consequence do not include many improvements of a strictly technical character, but show largely those with which the general public is immediately concerned. Naturally, those devices and appliances which are adapted for use in the household claim the greatest popular interest. At this year's show, which has just been brought to a close, the advantages of an electrically-equipped household were strikingly set forth in the exhibition of a model apartment. This comprised a living room, parlor, bedroom, dining room, kitchen, and butler's pantry, equipped throughout with all the latest electrical improvements. Here the spectator had an opportunity to examine in real life many of the appliances which, from time to time, he has seen illustrated and described in the columns of the SCIENTIFIC AMERICAN. Naturally, the kitchen, which is the housekeeper's workroom, afforded the best opportunity for the display of inventive ingenuity. Here an electric range was installed, furnished with oven, broiler, griddle, and three "stoves." This was large enough to do the cooking of a family of six. Other apparatus consisted of a meat chopper, a coffee grinder, an electric dish-washing machine, electric irons, etc. The cleanliness of electric cooking has made it possible to do some of this work in a small way on the dining-room table. The dining-room set comprised a chafing dish, coffee percolator, waffle iron, dish warmer, and the like. In the bedroom were the various devices of the toilet, heating pads, foot warmers, milk warmers, and electric lamps which could be turned low to give a dim light at night. In the parlor, aside from the artistic arrangement of the lights and the electrically lighted and heated grate, was a piano automatically played by a Tel-Electric player, and, whenever desired, orchestral music furnished by the Telharmonic system could be had by closing a switch. Electrical appliances for the household were not confined to this exhibit, but were also to be found in other parts of the building. There were various massage apparatus, hair driers, clothes-washing machines, portable vacuum cleaners, also laundry machinery, potato parers, meat choppers, and silver cleaners, made to do the work on a large scale for hotel use.

A feature of the show which aroused great interest was the operation of the cow-milking machine. Every afternoon at milking time a number of cows were milked by means of a vacuum milker operated by electricity. In this exhibit there were included a number of dairy machines, all electrically driven.

Many of the exhibits were very instructive. In one there was a section of a full-sized manhole of an electric main. This gave the public an opportunity to learn something about these mysterious chambers under our streets, and note the methods of splicing the huge electric cables. The method of manufacturing incandescent lamp bulbs was illustrated in practical form, the entire process being shown in actual operation. A lesson in the value of various lights was also given by showing a number of colored fabrics under different electric and gas lights. The introduction of electricity in the factory was shown by the large variety of machines and machine tools driven by electric motors. An elaborate exhibition of testing apparatus was a feature of the show which, if not of particular interest to the general public, was appreciated by the practical electrician. During the exhibition wireless telegraph messages were sent from one part of the building to the other. Altogether, the exhibition was a very successful one, and an improvement on that of last year.

THE SO-CALLED HYPNOTIC INFLUENCE OF SNAKES.

BY THOMAS C. HUTTEN.

It is a popular belief that serpents have the power of capturing their prey by casting a mysterious spell over the victims. Even scientists have seriously considered this supposed mesmeric power over birds. Cuvier ascribed it to narcotic effluvia; Audubon to the self-sacrificing audacity of nest-birds; Bonpland to the "instincts of curiosity and maternal devotion"; Russel Wallace to "optic influences, akin to hypnotism." The latter theory is the most generally accepted, and in the rural districts, both of Europe and North America, bird-charming snakes are classed with such indisputable phenomena as fish-deluding anglers. Contemporaries of more than average intelligence will describe the glaring eyes of a rattlesnake that paralyzed a youngster on his way to school, and maintain that they saw it charm down a squirrel from the top of a walnut tree.

An opportunity was afforded me last summer of disproving the snake-charm theory. The pharmacist of a medical college had procured a number of live serpents for experiments with certain antidotes, and, during the summer vacation, boarded his pets in a suburb of Bennington, Vt. They arrived in a moderate-sized drygoods box, and, with the owner's permission, my neighbor transferred them to a roomy outhouse, with a close-fitting door and a wire-screen front. Through a glass window their movements could be watched in spite of two bundles of straw and other aids to comfort. Cold weather lethargized them; but on warm afternoons, four of five out of ten rattlesnakes and six moccasins were generally in motion.

Were they trying to get out? Their conduct rather suggested a sanitary penchant for moderate exercise and sun-baths. And there seemed no doubt that they had a memory for meal-times. General revivals repeatedly preceded the gong by a minute or two. The owner's signboard, "Dinner at 3 P. M.," attracted rather a surplus of sightseers; and when it became known that our experiments promised to solve a problem of ages, catering, too, became superfluous: volunteer gifts of rats and blackbirds arrived in excess of our needs. Before the summer was over our visitors had settled the snake-charm controversy. Twenty-eight out of thirty intelligent witnesses agreed that there is no hypnotism about it.

Our first doubts were aroused by the complacency of birds and small mammals, and their absolute indifference to the presence of their formidable fellow-captives. Within two feet of a coiled rattler, a blackbird would alight on the rim of the drinking trough, and adjust the defects of his toilet, splashing water in the very face of the reptile that watched him with piercing eyes. Then, after repeated sips, he would condescend to notice the crawler that had uncoiled by that time, and would finally hop aside just far enough to avoid a dispute about bathing privileges, but still within easy reach of a strike. Nor had the restlessness of rats anything to do with the dread of immediate danger. They were trying to gnaw out, but, in the intervals of such efforts, were apt to run straight into the pile of straw that formed the favorite rendezvous of the serpents. The snakes, indeed, were in no hurry to abuse that confidence. When they did get ready, they scorned hypnotic artifices. A gradual elevation of the head, a noiseless approach with a short halt in reach of the bird that was picking crumbs in his feeding corner, then a slow contraction of coils, a snap-like dart, and a leisurely retreat, as from a task accomplished. The bird had taken wing, thoroughly alarmed, now, and fluttered about the wire screen in the desperate hope of finding a loophole of escape. In less than thirty seconds the poison began to take effect. The bird clutched at the screen, with his head hanging further and further back, then relaxed his grip, dangled by one foot for a while, and came flopping down on the floor. It was not dead yet, but dazed, looking this way and that, and fluttering about in a strange aimless fashion, and more than once right toward the destroyer, who at last began to manifest an interest in its antics. Once or twice the serpent, coiled near the center of the floor, seemed strongly tempted to risk a conclusive spring, but drew back again, fully aware, perhaps, that a better chance would be only a question of a moment.

The bird was still on the floor, staggering to and fro, when a sideward collapse marked the beginning of the end. Its foe watched it with lifted head. The chance had come. No risk of a rough-and-tumble fight now; the victim had ceased to flutter, and the old rattler quickly dragged it off to the straw pile. A full hundred experiments repeated this same sequence of maneuvers in all essentials.

The poison-fangs of a snake have no proper roots, but terminate in a virus-bag, and are attached to the jaw by means of ligatures that make them movable to the extent of erection and retraction. This arrangement makes it difficult, and rather superfluous, for the snake to secure his victim at the first spring. The fangs are adapted only for a snap-bite, but their owner can afford to bide his time. The virus that has been known to overpower strong men in half an hour, lethargizes birds and small mammals in half a minute. Wherever stricken, they are apt to collapse in sight, if not in direct reach of their assailants, whose keen eyes detect the slightest commotion in the neighboring weeds, but who would find it a very long time between meals if they had to rely on the hypnotic power of those eyes.

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Aluminium is increasingly used in machine construction, as in crank cases and gear boxes for motor cars, for paneling insides of underground railway cars, for electric wire, and for new alloys, pigments, and metal plating; and the aluminium cell as a lightning arrester has proved to be a valuable addition to lightning-protecting devices. During recent years the price of tin has been very high, and since adequate new supplies of ore have not been discovered, substitutes for tin must be used in manufactures. Aluminium is regarded as probably the most available substitute for tin in the great majority of uses to which that metal is put, owing to the diminution in the price of aluminium, the practically limitless supply of the raw material, and the favorable physical properties of the metal. As the production of aluminium is cheapened, so will the uses for it increase. The demand steadily keeps ahead of the supply.

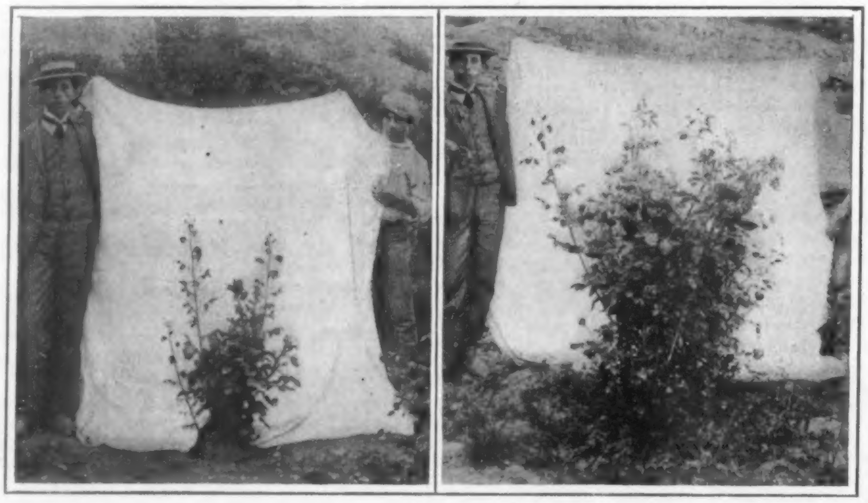
A NEW SYSTEM FOR THE FIXATION OF ATMOSPHERIC NITROGEN.

BY F. SAVORGNAN DI BRAZZA.

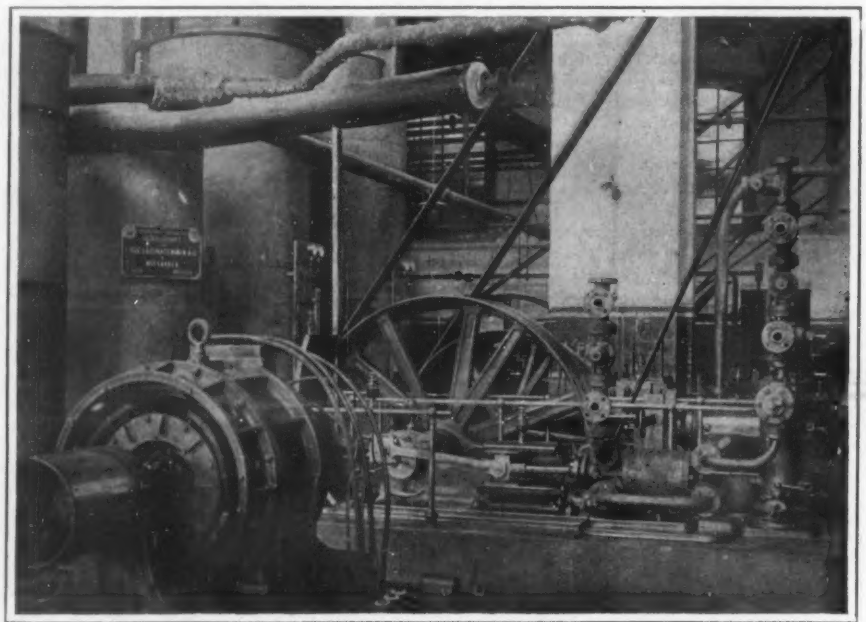
Nitrogen is the most important element entering into the nourishment and development of plant life. It is absorbed from the air by electrical discharges in the atmosphere, by the slow evaporation of water, and in other ways. At the same time, nitrogen plays by far the most active part in all fertilizers, whether of animal origin (in the shape of ammoniacal products) or of mineral origin, in which nitrates prevail.

The use of nitrogenized products in agriculture is ever increasing. This serves as a proof that the time is not far distant when the production of these will be entirely insufficient. The mines of nitrates in Peru and Chili will become exhausted as a matter of course, and all attempts to discover new mines to replace these—attempts made in all countries—have thus far given negative results only. This failure has caused apprehension, and presents a very serious problem for an epoch that is by no means far removed.

The endeavor has therefore been made to discover an industrial process capable of supplying an unlimited quantity of nitrogenized products at reasonable expense. The mind immediately recurs to the nitrogen in the atmosphere, which is practically inexhaustible. And, indeed, the fixation of atmospheric nitrogen is without doubt the most difficult problem that has presented itself to chemists and scientists in recent years. The difficulties to be overcome are indeed enormous; for, on account of its chemical properties, it is most difficult to fix nitrogen in the shape of a useful compound. Two processes only have been found practicable industrially, and promise to give excellent results. The first makes use of the electric spark; the second is the fixation of nitrogen upon carbides heated to a very high temperature.



Growth in Two Months of Simple Cultivation of a Plant Fertilized with Calcium Cyanamide.



The Apparatus for the Production of Liquid Air and for the Fractional Distillation Necessary to Separate the Nitrogen and the Oxygen.

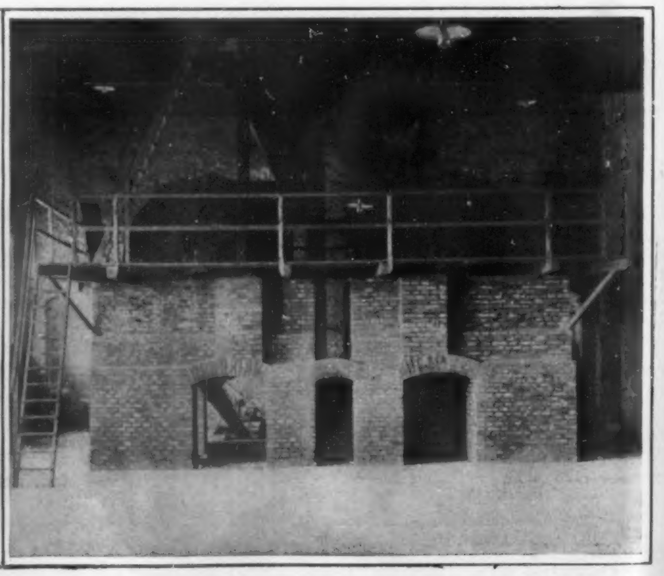
As early as 1785, Riesley had discovered that, in the presence of an electric spark, atmospheric nitrogen unites with oxygen to produce nitric acid, and that the air always contains traces of this acid after a violent storm. In 1869 Berthelot announced that a mixture of acetylene gas and nitrogen, when submitted to the electric spark, gave origin to cyanhydric acid. Just as soon as electricity began to be produced at low cost, the problem entered upon a new phase. The endeavor was now made to unite directly the two elements—oxygen and nitrogen—contained in the air by means of electrical discharges of various kinds. It was with this idea that there was established at Niagara Falls the Atmospheric Products Company, a company that utilized the patents of C. S. Bradley and S. Ross Lovejoy covering a process in which air that had been cooled and dried was submitted to an incessant rain of minute electric sparks.

Lately two Norwegians, Birkeland and Eyde, have continued the investigations of Siemens & Halske. They have succeeded in obtaining an industrial process that has given excellent results in fixing atmospheric nitrogen through the agency of electrical discharges. A factory is now being constructed for production on a large scale. We do not yet know the economic results of this process, which, theoretically at least, is excellent, but the proposed commercial production on a large scale would seem to indicate that the promoters of the process have confidence in its practical success.

In Italy a large factory, the first in the world, has been established recently for the production on a large scale of nitrogenized products obtained by the fixation of atmospheric nitrogen. It makes use of a new process discovered by Prof. Frank, of Charlottenburg, and Dr. Caro. The factory is situated at Piano d'Orte, in the province of Chieti. It employs hydro-electric power of 15,000 horse-power, drawn from the Pescara River, and it is estimated that in time it will have a daily output of over 13,000 pounds of the new product, which its inventors have called calcium cyanamide.

The process is based upon the property of calcium carbide to fix nitrogen at high temperatures. The inventors drew their inspiration from the experiments of Bunsen and Playfair, who obtained cyanides by passing nitrogen over a hot mass of carbon and alkalis. Drs. Frank and Caro suspected that the production of cyanides and nitrogenized products by this process were, perhaps, preceded by the formation of carbides. Experiments proved their conjectures to be true. Dr. Frank now endeavored to make use of barium carbide mingled with alkalis. He submitted the product, when heated, to a current of nitrogen, and at once obtained alkaline cyanides. Barium carbide, however, has one great drawback—it is entirely too costly to permit of its use in an industrial process. Calcium carbide, on the contrary, can be produced economically, and in great quantities. The substitution of this material for barium carbide constitutes, therefore, a noteworthy step in advance. It was then learned that calcium carbide, when raised to a temperature of 1,000 deg. C., fixes nitrogen directly, without the intervention of alkalis. The result is calcium cyanamide, $CaCN_2$. It was further proved that all the nitrogen in this new product, when united with water under high pressure, changes into ammonia, $CaCN_2 + H_2O =$

The New Italian Plant for the Fixation of Atmospheric Nitrogen at Piano d'Orte.



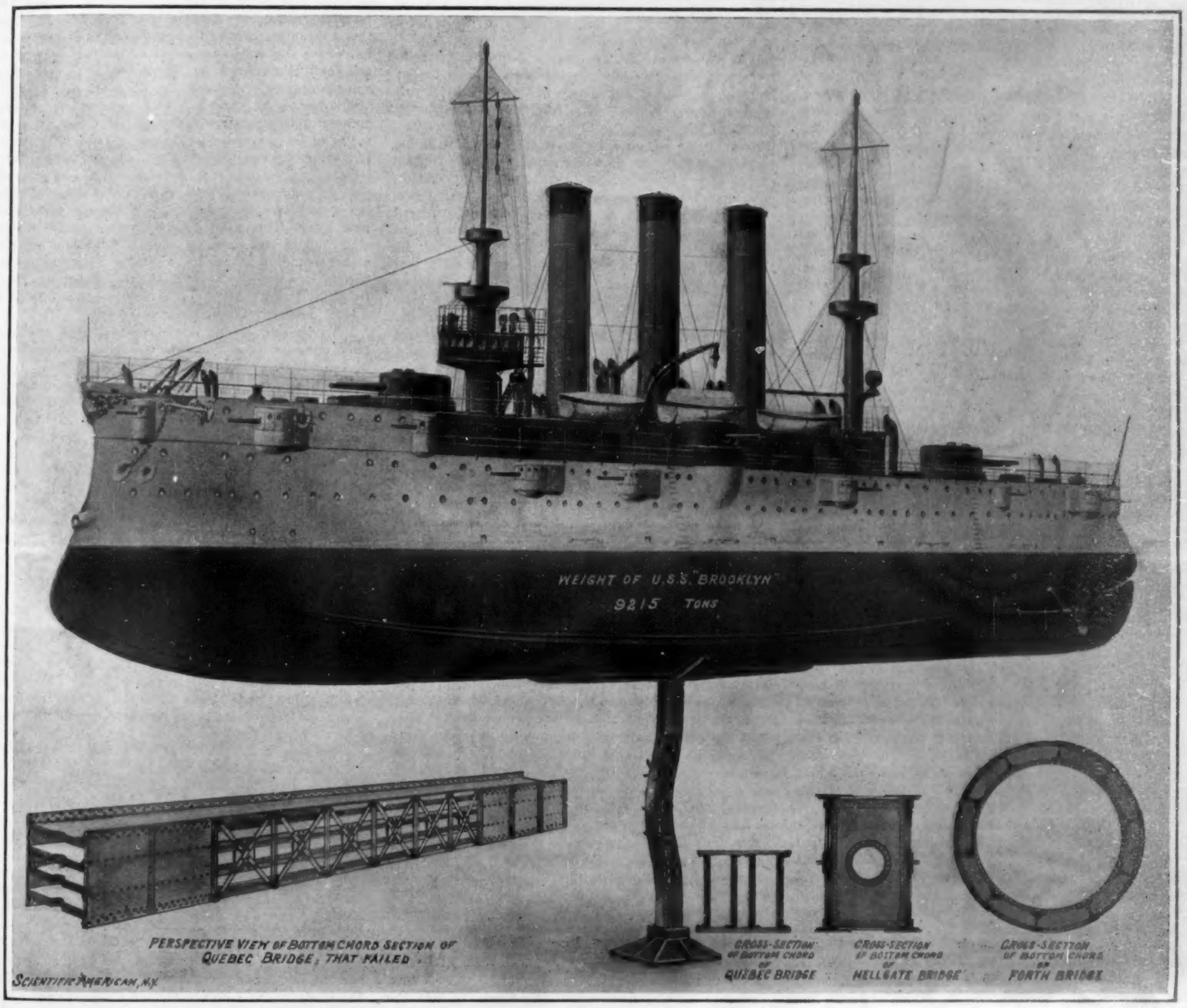
The Apparatus for Pulverizing the Calcium Carbide.

A NEW SYSTEM FOR THE FIXATION OF ATMOSPHERIC NITROGEN.

$CaCO_3 + 2NH_3$. This was the long-sought-for solution of the production of ammonia and ammoniacal salts by means of atmospheric nitrogen.

This production suggested the thought that calcium cyanamide might, under certain conditions, be used as a fertilizer, and might furthermore be directly applied to the nourishment of plants. Numerous experiments made in different countries gave favorable results, and it would seem, therefore, that the solution of the problem of the fixation of nitrogen for the production of useful compounds had at last been found.

It remained, however, to make this process economic, practical, and industrial. The necessary materials—calcium, carbon, and atmospheric nitrogen—were to be had everywhere, but the production of pure nitrogen in great quantities presented new difficulties. To obtain it directly from the atmosphere, it was necessary to separate it from the oxygen with which it is combined. The first attempt consisted in passing a current of air over copper filings very highly heated. The oxygen united with the copper, forming an oxide, and the nitrogen remained pure. But a process of this character was still too costly. It was therefore abandoned, and was replaced by a duly modified form of the Linde method. In this, the separation of the two gases is obtained by means of the liquefaction of air and fractional distillation, the boiling points of liquid nitrogen and of liquid oxygen being different. This constituted an economic process that could be very easily employed on a large scale.



The vertical post, which is shown in the act of breaking down under the load of the cruiser "Brooklyn," is drawn to scale and represents the lower chord member of the Quebec bridge which failed by buckling through the rupture of the latticing. Theoretically this member should have carried 11,820 tons; actually it failed under 8,000 tons.

GRAPHIC REPRESENTATION OF THE ENORMOUS LOAD WHICH THE COLLAPSED QUEBEC BRIDGE BOTTOM CHORD WAS SUPPOSED TO CARRY WITH A MARGIN OF SAFETY.

For reasons of economy, and owing to the immense power at the disposal of the plant at Piano d'Orte, the calcium carbide is here produced on the spot by means of a complete equipment of electric furnaces. The carbide is then ground to a very fine powder by special machinery, and is placed in special iron retorts. It is then heated until it fuses at a temperature of from 800 to 1,000 deg. C. At the same time, very powerful pumps blow over it a continuous current of nitrogen that has been separated from liquefied air by the fractional distillation mentioned above. After a couple of hours, the carbide is transformed into calcium cyanamide ready for use.

Calcium cyanamide as obtained from the retort has the appearance of a very dark mass, composed of extremely fine crystals and of free carbon. Furthermore, it always contains a small quantity of calcium carbide that has not become transformed. Therefore, after grinding the product very finely, it is necessary to expose it for some days to the air, in order that the small quantity of water vapor in the air may remove the portion of calcium carbide still remaining.

Calcium cyanamide, the *Kalkstickstoff* of the Germans, contains from 14 to 24 per cent of nitrogen, 40 to 42 per cent of calcium, and 17 to 18 per cent of carbon. If calcium cyanamide be again placed in a retort, it changes to a cyanide.

In the results when applied to agriculture, the new product has proved itself equal, if not superior, to various other mineral fertilizers, among others the nitrates of Chili. This process demands, however, very great electric power, and its application will prove useful only where great electric power can be provided at a small expense.

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The dangers of European ballooning were emphasized during a long-distance race from Paris on September 29, for the grand prize of the Aero Club. Rain or fog circled the aeronauts throughout the race, and a southerly wind drifted them seaward. M. De Lobel, one of the competitors, finding the sea ahead, determined with his two companions to risk reaching England; but a change in the wind carried them back over the North Sea, which they struck twenty-five miles from Ostend. They were thrown into the water, but grasped the cordage and regained the balloon. De Lobel tied himself to the car and his companions to the rigging. They passed several hours thus, looking out for a ship, and were finally picked up by a German boat and landed at Dover.

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WHY THE QUEBEC BRIDGE FAILED.

The Quebec Bridge fell because of the buckling of the bottom chords, and the bottom chords buckled because the four ribs or webs of which each was built up were not sufficiently braced together to enable them to act as a whole.

In a previous issue we stated that the first failure occurred in the left-hand bottom chord of the anchor arm in the second panel out from the main pier. Subsequent detailed examinations of the wreck show that, simultaneously with the failure of the left-hand chord, the corresponding right-hand chord collapsed in a similar manner, being buckled into the form of the letter S. Furthermore, the later investigations have revealed the fact that the whole of the bottom chord members had shown signs of weakness which were sufficiently disconcerting to cause comment and considerable anxiety among the workmen on the bridge. Of this there seems now to be no doubt whatever. Evidently, at the time of the disaster, the various struts, posts, and chords throughout the whole bridge, but particularly the chords, were suffering from overstrain and were trembling on the verge of collapse. It was merely some local action that caused the break to happen just where it did. Probably there were a score of other compressive members which might have failed as readily as this one.

At the same time, we are confronted with the significant fact that, regarding the tension members, that is the eye-bars, there had never been any anxiety whatever on the part of the erecting gangs; everybody connected with the bridge, from riveters up to chief engineer, being perfectly satisfied that these members were standing well up to their work. Furthermore, the tension members passed through the terrific ordeal of the final collapse of the bridge with a really mar-

velous immunity from fracture, only one single bar out of the many hundred in the bridge being ruptured. The conclusion at which practically every engineer who has examined the fallen bridge, and made a careful study of the strain sheets, etc., has arrived is, that there was something radically wrong with the design of the large compression members, and particularly the bottom chords. In this opinion we entirely concur, and for the reasons which are given below.

The general public has but a faint idea of the enormous stresses to which the members of a cantilever of the size of the Quebec Bridge are subjected. The chord member which failed was *supposed* to have a safe strength of 9,312 tons; that is to say, it could be subjected to an end pressure of this enormous amount without any signs whatever of deflection or buckling. In order to illustrate just what this means, our artist has prepared the accompanying drawing showing this member, 57 feet in length and measuring 5 feet 7 inches by 4 feet 6 inches in section, stood on end on a suitable pedestal, and carrying the United States armored cruiser "Brooklyn," whose weight is 9,215 tons. Now, according to the calculations of the engineers, this member should not only be capable of carrying the load of the "Brooklyn" without failure, but it should be possible to add as an additional load, say, the cruiser "Marblehead," of 2,100 tons weight, before the column would begin to show signs of distress, the total load of over 11,000 tons representing close to the elastic limit of the material, or the point at which the steel would begin to yield without recovery. Now, 11,320 tons represents the maximum possible load which it was estimated could come upon this member, due to the weight of the bridge itself, plus the weight of the live load, that is trains, vehicles, foot passengers, etc., plus the load due to a heavy wind storm. And, right here, we cannot but express our surprise that this member should have been made so light that, in the event of the maximum live load and the maximum wind pressure occurring at the same moment, the metal would be strained almost to the elastic limit. This is cutting matters down to a fine point with a vengeance. We understand that those who are responsible for the design claim that the probability of the conjunction of a maximum live load and a maximum wind storm was considered to be so remote as to be negligible in the computations. They considered, furthermore, that this contingency was preventable, since it would be possible in the event of a heavy windstorm to prevent more than a limited amount of traffic on the bridge. This was certainly a most astounding presumption; for it is always possible that a fully-loaded bridge may without warning be subjected to a gale of wind or even a tornado.

However, as a matter of fact, this compression member failed under a load of about 8,000 tons, or less, this being the calculated load which was upon the bottom chord at this point, when the bridge went down. How comes it then, that failure should have taken place when the chord was strained to only about two-thirds of its calculated strength? An examination of the drawing of this member, as here given, and of the direction in which it yielded, affords conclusive evidence that it gave way because the latticing which is supposed to hold its parts in true line was utterly inadequate to do so.

The member consisted of four deep parallel webs, or ribs, 4 feet 6½ inches in depth, each built up of four thicknesses of steel plate riveted together, and having a total thickness of about 3½ inches. Now the veriest tyro can understand that these four plates, 57 feet in length and 4 feet 6½ inches in width, if stood up on end, parallel with each other, would be capable of carrying but a very small load before they began to buckle out of shape. To render them capable of load carrying, they would have to be braced firmly together with a view to keeping them in true line. This fact can be illustrated in a homely way by taking an ordinary walking cane and leaning upon it. Before much pressure was applied it would begin to spring out of line. If it were held at its middle point, it would carry a much greater weight before deflecting, and if it were supported at three points, a greater load yet, and so on. Now the method adopted for preventing deflection of the ribs of the Quebec Bridge chords, transversely to their planes, was to tie them together at their edges with a latticing of diagonal angles, each measuring 4 inches by 3 inches and ¾ inch in thickness, and transverse struts consisting of angles 3½ inches by 3 inches by ¾ inch in thickness. This latticing, or trussing as it might be called, was riveted to the tops of the webs by ⅞ rivets, there being two rivets at each point of contact. *Theoretically*, these angles should have been sufficient to hold the webs in true line, that is, to hold them exactly parallel with the longitudinal axis of the chord member. *Theoretically*, if the ribs were absolutely true, and if the load of 9,000 or more tons was applied concentrically and in an absolute axial line with the member, there would be no stress on the latticing. As a matter of fact, not even the most careful manufacture can insure such mathematical exactness. The individual plates, and the columns as a whole, are certain to be somewhat out of line. Moreover, because of slight and unavoidable inaccuracies in manufacture, the load might be applied somewhat eccentrically; that is to say, it might bear more heavily on one edge of the column than the other. This might be further aggravated by the fact that the rivets of the latticing did not entirely fill the rivet holes, allowing a slight deflection of the whole column, until the angles of the latticing were under stress. Then there would be a tendency to tear the latticing apart, either by the rupture of the lattice angles, or, what is more likely, by the shearing off of the rivets. Undoubtedly this is what occurred in this member. In fact, two or three days before the disaster, the inspector had observed that the webs had actually sprung out of line from an inch and a half to two inches, and before the warning had been heeded and load taken off the bridge, the latticing tore asunder, and the thin and now unbraced web plates buckled like the walking cane above referred to, and twisted into the S form in which they now lie beneath the pile of wreckage.

It is our belief that not only was the lattice reinforcement absurdly light for the work it had to do; but that the outside dimensions of this member, which measured only 4½ feet by 5½ feet, were altogether too slight for the chords of a bridge of this enormous size. This criticism is borne out by a comparison with the sections, shown in our engraving, of the bottom chords of two other notable bridges, one the 1,000-foot, steel, arch bridge about to be built at Hell Gate across the East River, and the other the celebrated Forth Bridge, whose cantilevers have a span a little less than that of the Quebec Bridge. In the case of the Hell Gate Bridge the bottom chord measures 7 feet by 8 feet 6 inches; and, although the total combined dead, live, temperature, and wind loads have a total of only 8,420 tons, the total area of metal at any point of section is 811 square inches, as against 735 square inches in the Quebec Bridge, whose total load, as we have seen, is estimated at 11,320 tons. Moreover, the metal of the Hell Gate chords is distributed around the circumference, instead of across the whole member; and in place of light angle latticing it is stiffened throughout with solid cover plates, and has three one-half inch diaphragms, with stiffening angles, extending across it at three points of its length. The Forth Bridge bottom chord is an even stiffer construction than this. It consists of a tube 12 feet in diameter, built up of ten 12-inch longitudinal I-beams, riveted to an outer shell 1¼ inches in thickness, with circular stiffening webs worked in at 8-foot intervals throughout the whole length of the tube.

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THE GAMMETER ORTHOPTER—A BEATING-WING FLYING MACHINE.

BY H. C. GAMMETER.

The accompanying illustrations depict a beating-wing flying machine of my invention, the principal dimensions of which are the following: Width, 30 feet from tip to tip; length, including the rudder, 12 feet; area of the body, including the rudder, 48 square feet; area of the wings, 154 square feet; total area, 202 square feet; weight, 290 pounds, including fuel and gyroscope; weight with operator and fuel, 440 pounds; engine rated at 7 horse-power; weight of engine with clutch, 70 pounds; speed of engine, 1,200 revolutions per minute; speed of wings, 75 vibrations per minute.

As yet no outdoor tests have been made with this machine, for the reason that I was unable to continue my experiments at the time that I most desired to do so, and that it would have proven embarrassing to drop them, once begun. Moreover, they must, of necessity, become public in any attempt at free flight. Thus, I may mention that my indoor tests were very encouraging indeed, and prove that I have ample power to lift the machine entirely from the floor the instant the clutch is released. Owing to the confined area in the room in which I conducted the experiments, I was not always successful in causing the machine to rise. When suspended, the orthopter indicated a forward pull of approximately 24 pounds. These figures are, of course, indefinite, because the circulation of air within a confined space prevents any accurate measurement. Lack of experience in steaming and bending bamboos for the wings has left the material soft and weak. Hence, the necessity of piano wire stays.

The Editor of the SCIENTIFIC AMERICAN has expressed a doubt as to my ability to rise with a seven horse-power engine. This doubt is justifiable if the engine does not develop more than one-half its rated horse-power, which is frequently the case. But with seven actual horse-power, I fail to see why I should not succeed on a principle which is faithfully copied from nature. While I cannot hope to work as accurately as nature, yet with a seven horse-power motor I should have at least four times as much power as nature employs to do the same thing, after deducting fifty per cent for friction. Because I intended to experiment over water, I use inflated canvas-covered rubber floats, which appear in the illustration. But owing to the lateness of the season and the bad weather of autumn, I will substitute wheels and run on land.

For several years past I have made a very careful study of the principles of aerial navigation, and have closely followed the experiments of Langley, Maxim, Manly, and others, besides devoting most of the past winter in Florida to observations of birds in flight. I have come to the conclusion that as nature teaches us how perfect flight may be obtained, it is advisable to copy her as freely as possible, at least for a beginning, and then to modify our designs to suit the conditions of artificiality. The enormous lifting power of movable wings always impressed me very forcibly.

In my first experiments I will depend entirely upon wings for lifting and propulsion. It is evident from the accompanying illustrations that the anterior edges of the wings of my machines are rigid, while the posterior edges are flexible, so that the wings may act as propellers, both on the up and down strokes. In form the wings are a close copy of a bird's, except that the outer three-fifths are valvular, so as greatly to reduce the resistance on the upstroke. Owing to the angle taken when the wings are open, they assist considerably in propulsion.

The feature in which my work has been exceedingly successful is the transmission of the power from the motor to the propelling mechanism. This transmission is not only exceedingly light and strong, but very simple and efficient. It consists of a light 20-inch gear of manganese bronze (preferably steel) containing a ball race cut into the face, leaving teeth upon both sides. This gear in turn revolves within a rigid ring held in the frame of the machine, and contains a corresponding groove for the balls. The ring at the bottom contains the bearing for the pinion (16 to 1) from the internal cone clutch, controlled by means of a lever adjacent to the steering wheel.

Rods leading to the wings connect with the gear from opposite sides, and clear the horizontal supports of the wings.

The wings are hinged at two points to the tubular frame, 30 inches apart. Two diagonals meet the braces on the bamboo, and converge at a point in line with the connecting rods. Thus, it will be seen that the thrust of one wing is virtually in line with the other, which permits both a light and strong construction.

It is in this respect that Blériot and others have failed in their attempts at constructing a beating-wing machine. Only one rudder will at present be used. This is balanced horizontally, and is controlled by means of a cable leading to the steering wheel. The wheel also contains a spark advance and throttle lever, as in an automobile.

The body of the machine is made of steel tubing 16 to 22 gage, while the wings are of common bamboo covered with Japanese silk.

Foremost in importance of all the features of a flying machine is the question of stability. This important problem, without the complete mastery of which aerial navigation can never succeed, has offered great difficulties in all attempts thus far made; and when success was finally achieved by Langley, it was only after many discouraging attempts.

In my machine stability is obtained by means of a low center of gravity, by requiring the operator to shift his weight and by keeping the area of the machine as small as possible, to eliminate danger from wind gusts.

More important than either of these, perhaps, is the placing of an inclosed horizontal flywheel in the center of the plane. It is almost incredible what resistance this wheel at 1,500 R. P. M. offers to any sudden change in direction. After a very careful study of the true gyroscope, I abandoned it as too complex. Provision is also made for a propeller, but merely to test the efficiency, as I do not believe I shall use it, unless it is deemed desirable to do so after being thoroughly launched in the air, in which event the wings may be held rigid and the propeller used. I hope to compete for the SCIENTIFIC AMERICAN trophy with this machine.

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Pennsylvania Railroad Prizes to Employees.

During this month the Pennsylvania Railroad will distribute $5,400 in prizes to the men whose tracks have been kept in the safest and most perfect condition in the last year. The main track will first be judged by engineers of the Maintenance of Way Department and the Division Superintendents, to be followed two weeks later by the General Manager's annual inspection. On this trip he will be accompanied by a party of about 200, traveling in the company's special track observation cars. General Superintendents, Division Superintendents, assistant engineers, supervisors, and their assistants will compose the party.

There are to be one $1,200 prize, four $800 prizes, and one prize of $1,000. The $1,200 premium for the best line maintained throughout the entire year; the $1,000 premium for the supervisor's division showing the greatest improvement in the year.

Correspondence.

Brooklyn Bridge Moving Platform.

To the Editor of the SCIENTIFIC AMERICAN:

My attention has been called to the article published in the SCIENTIFIC AMERICAN last Saturday in reference to the proposition to place a moving platform on the Brooklyn Bridge.

This plan was indorsed by the Prospect Heights Citizens' Association of Brooklyn last winter, after the most careful consideration, as the best means of solving the bridge problem.

Your reference to the prevention of through traffic leads me to call your attention to the fact that the moving platform is the only system of transportation that it is possible to carry across and down town.

We believe the moving platform should be installed at once on the bridge; and extended at the earliest possible moment by a subway loop across town and down town, and thereby enable a great majority of passengers over the Brooklyn Bridge to board the platform without the necessity of walking to the bridge terminal.

The streets and sidewalks of lower Manhattan are overcrowded now; and our public officials should adopt a policy that would result in the distribution of traffic, rather than a policy that would increase the congestion and concentration, as would be the case if any terminal plan or bridge loop plan were adopted.

JUDSON G. WALL,
President Prospect Heights Citizens' Association.
Brooklyn, New York, September 24, 1907.

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Telephone vs. Telegraph Train Orders.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the inclosed letter, headed "The Evils of Train Telephone Orders," signed by F. H. Sidney, Signal Department B. & M. Terminal Division, and appearing in your issue of September 14, we desire to take issue with Mr. Sidney on the statements in his letter. We think we can give very much better reasons for our statement that the telephone is not only as good but better and safer for train dispatching than the telegraph than Mr. Sidney has for his statement that the telegraph is the only safe method.

Mr. Sidney, on the basis of one accident, jumps at a conclusion which is unwarranted. The inclosed statement of the cause of the disastrous wreck on Mr. Sidney's own road, which occurred at Canaan, N. H., on September 15, is but too sad a proof that orders over the telegraph may be misinterpreted with the most disastrous results. This in itself answers Mr. Sidney's letter fully, and fully proves the weakness of his position and of his reasoning as stated in his letter of September 3.

Furthermore, we have this advantage over him as between the wreck at Mattoon, Ill., and that on his own road. The electric road at Mattoon, Ill., was not regularly dispatching its trains by telephone or any other means, was without a regular train dispatcher, was without any standard of rules or discipline for handling trains by the dispatching method. This road was without system; and the fact that an accident occurred because of a misunderstood telephone message in no way condemns the use of the telephone, but condemns any unsystematic and haphazard method of operation, such as seemed to be employed. The accident on the Boston & Maine occurred on an old steam road that has been using the dispatching system for years, and has standard rules and regulations for this system. Furthermore, the accident happened between two well-trained and competent telegraphers, who had been in the service of the road for years.

We are not content, however, with answering him in kind. We go further, and dare to make the statement that the telephone, when properly used in connection with a reliable dispatcher's signal, may be made a safer and altogether better means of dispatching trains than the telegraph.

In the first place in using the telephone the conductor should go to the telephone, receive the order from the dispatcher, write down what he hears on an automatic triplicator, and repeat back to the dispatcher what he has written: the dispatcher then giving him an O. K., conductor signs his name and goes on car or train, then the engineer or motorman goes immediately to the telephone, and reads what the conductor has written back to the dispatcher. Again, upon receiving a "complete" from the dispatcher he signs the order, takes the original for himself, hands the duplicate to the conductor, and leaves the triplicate copy locked up in the machine for the management. It is obvious that this method prevents possibility of mistakes due to the unaccountable mental lapses of humanity, mistakes such as a transposition of figures and so forth, because one man is reading what another man has written, and you thus have a check on all orders.

When so used we repeat again that the telephone, in connection with a reliable dispatcher's signal, such as there is now on the market, is a better and safer means of handling traffic than the telegraph.

When the dispatcher is speaking direct to the train crew, as he is with the telephone, he is communicating direct with the men whose lives may depend on the proper understanding and execution of the order, whereas with the telegraph the dispatcher is giving the order to a third person.

Again, a mistake is much less apt to be made if you give an order to a person direct, as you do with the telephone, instead of giving it through a third person to be repeated by him to someone else who is to execute the order, as is done with the telegraph. It is well known that the greater the number of hands through which an order has to be passed, the more liable the order is to be misinterpreted or misunderstood.

Finally, the telegraph is a more or less slow and cumbersome means of transmitting a message, and orders must be reduced to the least possible words. Very often, however, the addition of a single word may enable the person receiving the order to better understand it. This additional word can be given over the telephone without causing any delay.

It is frequently claimed that the telephone, because it transmits sounds, is liable to errors and misunderstandings; that a word or a number spoken over the telephone may be misinterpreted or misunderstood. This is perfectly true, but does not exactly the same argument apply to the telegraph as well? The telegraph transmits its message by means of a series of sounds, which are just as capable of being misunderstood or misinterpreted as sounds over the telephone. Indeed, the sounds over the telegraph are so short and follow each other so closely, that they require an extremely well-trained and expert operator, with his mental faculties exceptionally clear and active to understand them at all. Therefore, we repeat again that in connection with a reliable semaphore signal, under control of the dispatcher, the telephone is a better, safer, and quicker means of communication than the telegraph.

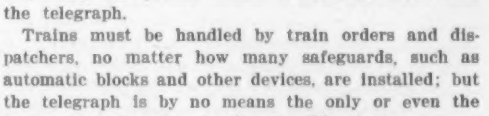
Trains must be handled by train orders and dispatchers, no matter how many safeguards, such as automatic blocks and other devices, are installed; but the telegraph is by no means the only or even the best means of communication for this purpose.

BLAKE SIGNAL AND MANUFACTURING COMPANY,
E. J. BURKE, President.
Boston, Mass., September 24, 1907.

A STRONG HOME-MADE TURNBUCKLE.

BY L. W. M'CAUGHREY.

Requiring some small turnbuckles which would stand a sudden strain, I hunted through the hardware stores of New York without success. I could obtain none small enough, having the left and right hand bolts cast in one piece to the rings at their ends. I tried the buckle with bolts made of wire threaded at one end and bent into a ring at the other, but the moment a load was applied the ring opened. Next I tried those with a swivel at one end, but in every case the riveted neck of the swivel pulled out.



A STRONG HOME-MADE TURNBUCKLE.

I then determined to make my own, but found that small left-hand taps and dies were only to be obtained, and not promptly, from the factory.

All told, I required a dozen turnbuckles. So I bought two feet of ⅜-inch Shelby steel tubing, No. 13 gage, and one foot ½-inch No. 11 gage. Also one dozen ¼-inch bolts and nuts, and one dozen ¼-inch nails with heads ⅛ inch thick. The material cost seventy-five cents.

I cut the material into required lengths and counterbored *B* with a ⅜-inch drill to slip over the end of *A*. The head of the nail *C* was filed to fit the counterbore, and after inserting it in *B*, its end was flattened and a hole drilled as shown. *B* was then riveted to *A* at *D*, using a 5/32-inch wire nail. The other end of *A* was tapped for the right-hand bolt *F*, the end of which was flattened and drilled like the nail *C*. A 5/32-inch hole *E* was drilled for a pin or nail for tightening the buckle.

The whole twelve were made, entirely by hand, in nine hours, or forty-five minutes each.

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The aeronautical contest at St. Louis on October 21 will be, given fine weather, an assured success. As now arranged only nine balloons will take part in the international race—three from America, three from Germany, two from France and one from England. Other countries were barred because they failed to comply with technical requirements of the International Aeronautic Federation. Two of the German competitors arrived on October 1, and expressed an opinion that St. Louis was an ideal spot for the commencement of a long distance race. In Europe there is always the chance of drifting to sea—about the only danger which aeronauts really fear, and the sea is far from St. Louis. With a southerly wind the great lakes may be reached or crossed, but there is little fear of disaster there, for the lakes are crowded with shipping and everyone will be on the lookout for the balloons. A number of members of the Aero Club of America will leave New York for St. Louis, on the Pennsylvania Railroad, on October 17. The St. Louis headquarters of the club will be the Jefferson Hotel.

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Official Meteorological Summary, New York, N. Y., September, 1907.

Atmospheric pressure: Highest, 30.41; lowest, 29.55; mean, 30.01. Temperature: Highest, 85; date, 21st; lowest, 46; date, 26th; mean of warmest day, 76; date, 17th and 21st; coolest day, 52; date, 26th; mean of maximum for the month, 74.3; mean of minimum, 61.3; absolute mean, 67.8; normal, 66.4; excess compared with the mean of 37 years, +1.4. Warmest mean temperature of September, 72, in 1881. Coldest mean, 61, in 1871. Absolute maximum and minimum for this month for 37 years, 100 and 40. Average daily deficiency since January 1, —1.1 Precipitation: 8.00; greatest in 24 hours, 2.68; date, 28th and 29th; average of this month for 37 years, 3.69. Excess, 4.31. Accumulated deficiency since January 1, —1.48. Greatest September precipitation, 14.51, in 1882; least, 0.15, in 1884. Wind: Prevailing direction, south; total movement, 7,632 miles; average hourly velocity, 10.6 miles; maximum velocity, 43 miles per hour. Weather: Clear days, 7; partly cloudy, 6; cloudy, 17; on which 0.01 inch or more of precipitation occurred, 13. Thunderstorms: 3d, 4th, 11th, 21st, 22d, 23d, 24th.

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Naval Wireless Telephony.

The Navy Department is supplementing wireless telegraphy on warships with wireless telephony; it is hoped that all the battleships which are to start in December for the Pacific will be equipped. Telephones have been installed on the "Connecticut" and "Virginia," and communications have passed between them at a distance of twenty-two miles. Ships which were equipped with wireless telegraphy but not wireless telephony could distinctly hear through an ordinary telephone receiver what was said in the transmitter aboard another ship. Mr. De Forest, who is overseeing the installation, when on the "Connecticut" talked into the transmitter of the wireless telephone, and the operators on the "Kentucky" and "Illinois," although those ships were not equipped with wireless telephones, attached telephone receivers to the wireless telegraph instrument and heard distinctly conversational tones of Mr. De Forest. The "Kentucky" and "Illinois" were eleven miles from the "Connecticut."

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The Current Supplement.

In the current SUPPLEMENT, No. 1658, Dr. W. Michaelis presents his views on the merits and limitations of cement and concrete and on the cause of failure in concrete construction. He suggests means for the prevention of such failure. He discusses his subject as a consulting engineer who is familiar with both the details of the manufacture of cement and its chemical and physical properties, and with the use of cement as a building material. The second installment of Prof. A. E. Watson's treatise on Elementary Electrical Engineering is published. It deals with the dynamo. William O. Eddy and Melville Eastham's splendid paper on the design of induction coils is concluded. During recent years parts of north Africa bordering on the Mediterranean have proved a rich mine for archæologists. The ruined wealthy cities which are the only evidence of ancient Roman occupation are very fully described by the Paris correspondent of the SCIENTIFIC AMERICAN, with the aid of copious illustrations. Under the title of "Vital Rhythm," Dr. A. Drezwina dilates on the importance of habit in biological phenomena and vital periodicity in plants and animals. J. F. Lanneau contributes an eloquent article on the measureless remoteness of the stars. The reconstruction of a steel bridge for the Strabane and Leterkenny Railroad over the River Foyle, Ireland, is an interesting departure from the general procedure in connection with the building of piers. This departure is excellently described by the English correspondent of the SCIENTIFIC AMERICAN in an article entitled "The Application of Ferro-Concrete for Bridge Foundation Caissons." The Barbazat gas turbine and centrifugal air compressor is described by the Paris correspondent of the SCIENTIFIC AMERICAN. Entirely new principles are involved in the construction of both machines. J. H. Morrison's paper on the development of armored war vessels passes to a seventh installment, in which the Confederate armorclads and the Union attempts at armor plating vessels are considered.

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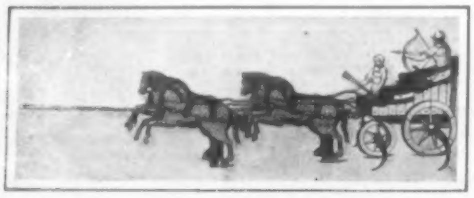
The night illumination of Niagara Falls, which was first done on September 2, has proved a great spectacular success. Thirty-one searchlights were used, and 25,000 spectators witnessed the first illumination. In a later issue we shall give particulars of the installation, and illustrations of the effect produced.

WAR CARS, ANCIENT AND MODERN.

BY LIEUT.-COL. C. FIELD.



A Medieval Conception of a Persian Chariot.

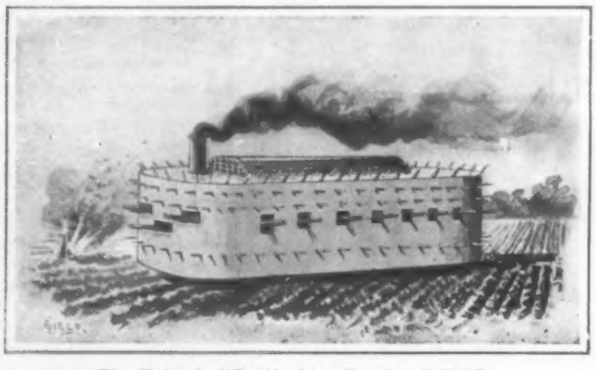
An Egyptian War Chariot.

Wheeled vehicles have been applied to purposes of warfare ever since the Egyptians invented the war chariot 4,000 years ago. After a comparatively short interregnum of 200 or 300 years they are again coming to the front, thanks to the evolution of the internal-combustion motor. It is not proposed to go into the question of wheeled transport, whether for stores or men, but so far as the limits of a short article will allow, to glance at the various vehicles which have been from time to time designed to take an actual part in the fighting itself. We must eliminate the ordinary field gun, which may be regarded merely as a weapon provided with wheels which enable it to be hooked on behind a limber or a small ammunition cart, and may be classified with vehicles intended for transport. The Holy Bible is full of allusions to war chariots. We may refer to the 600 belonging to Pharaoh which perished in the Red Sea; to that of Jehu, whose furious driving caused his identity to be recognized afar off, and to the 30,000 chariots which the Philistines brought to the battle of Michmash. These chariots or war cars were drawn by a pair of horses harnessed on either side of a pole and were, as a rule, only big enough to carry one warrior and his driver. The earlier ones were possibly square, but the later ones were horseshoe-shaped and remarkably well finished. A perfect specimen may be seen in the Archæological Museum of Florence. It was found in a tomb at Thebes and is considered to date from 1400 B. C. Like our modern motor cars, the bottoms of these chariots were very low, so that the occupants could easily jump in or out. Eastern nations, notably the Persians, adopted the war chariot. In fact, Ninus, King of Assyria (B. C. 2059), according to some authorities, is considered to be its inventor. In any case they improved on the Egyptian chariot by fitting curved scythes or knives to the axles, so that dreadful wounds would be inflicted by the vehicle itself as it was driven through the ranks of the enemy. The heroes of the siege of Troy appear to have used the chariot merely to bring them to close quarters with their enemies, for they are always represented as leaping to the ground to fight. The ancient Greeks and Romans copied the war chariot from the eastern nations, but with their more scientific and regular study of warfare soon discarded it, recognizing that it was of no use in rough or hilly ground, and that though it might be formidable enough in a plain, there was always the risk that the horses might be stampeded or driven back into their own ranks with disastrous effect. Added to this disadvantage was the ease with with which a slight obstruction would impede the speed of the chariots or stop them altogether.

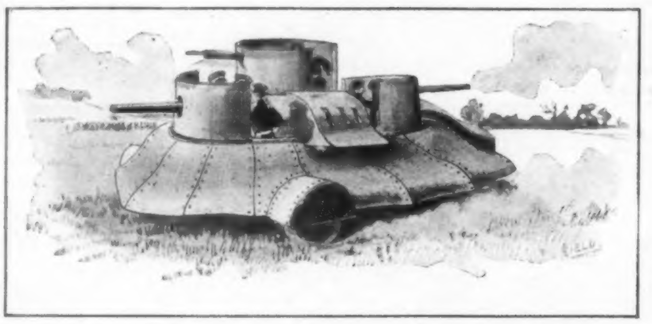
Vegetius, in his "De Re Militari," gives an illustration of a four-wheeled chariot or "quadriga" drawn by four horses carrying a large number of soldiers and equipped with a most bristling array of scythes and spikes. Another contrivance he depicts can hardly be called a chariot, consisting as it does merely of a pair of wheels fitted with scythes, and an extraordinary arrangement probably designed to prevent the enemy from hanging on behind. The driver is mounted upon one of the pair of horses which draw the machine and is embellished with a pair of wings the use of which it is difficult to imagine. If these vehicles did not remain long in favor with the classical nations, the use of them spread to all the more savage peoples of antiquity. The wicker-work chariots of the Britons with their sharp scythes were famous on account of the dashing pace at which they were driven and by their means Cassivellaunus inflicted severe loss on Cæsar's legions. The Scythians and Teutons also used similar cars, and not very many years ago two four-wheeled war chariots were unearthed in Jutland.

In medieval ages war chariots had quite gone out of fashion, but after the invention of gunpowder there was in some quarters a considerable use made of war carts. These vehicles occupied, for a time, the place later taken by the field gun. The earlier cannon—with some notable and ponderous exceptions—were something between the smallest kind of field piece and the "handgonne."[*] When the "men of Ghent" advanced to the defeat of the Earl of Flanders before Bruges in 1382 they had with them, according to Froissart, no less than "200 carts loaded with cannon." Judging from what follows, each cart carried one or two cannon; for directly the Earl's troops advanced, "the men of Ghent fired 300 cannons upon them." This seems to have been the only discharge, so long did it take in those days to reload. Later on, the war cart developed on the one side into the field piece and on the other to the "orgue" and "ribaudaquin" vehicles carrying a number of light gun barrels, either side by side or in a bundle and provided with an array of cruel-looking pikes and spears to keep infantry or cav-

The Latest French War Car, 1907.

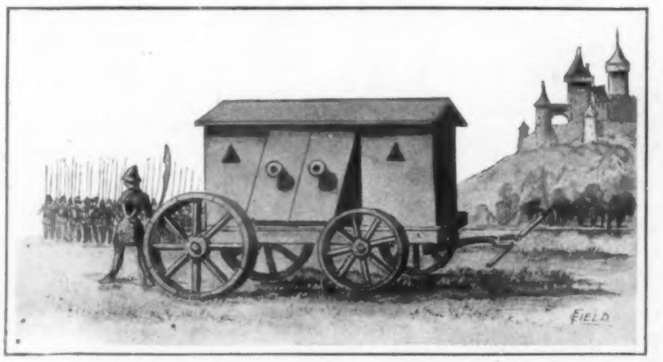


The Kaiser's "Battle Line Breaker," 1897.



Proposed Improvement on Pennington's Car, 1900.

An 18th Century Suggestion.



A German War Car with Cannon. 15th-16th Century.

F. R. Sims's Fortress Car, 1902.

An English War Car in the Middle of the 16th Century.

WAR CARS, ANCIENT AND MODERN.

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[*] Monstrelet mentions that in 1418 "the Lord of Cornwall . . . crossed the Seine . . . having with him in a skiff *a horse loaded with small cannons.*"

alry at arm's length. These contrivances were the machine guns of the Middle Ages. In Germany especially the war cart proper continued for some time, at one period assuming the form of a European bathing machine carrying one, two, or more cannon and affording a considerable amount of protection to the guns' crews. These were probably a vast improvement on those we have referred to as used by the "men of Ghent" which were most likely ordinary vehicles fitted with cannon.

Henry VIII. of England had with him a number of specially designed war carts at the famous Field of the Cloth of Gold, if we may rely on the old paintings of that event. They were apparently intended for the transport and protection of infantry (probably archers) only, as they carried no guns and were pierced on all sides with several tiers of loop-holes. When on the move in action the horses were inside between the wheels and the soldiers occupied the upper portion only. Gun carts are represented in the same picture, but they were practically small, double-barreled field guns, breech loading, and covered with a long conical shield. But the progress of the evolution of the field gun and the portable musket soon abolished the war cart, and for practical purposes it did not appear again till the present time, when the perfection attained by the automobile has opened new possibilities in its use.

During the last century more or less vague ideas of steam-impelled vehicles adapted for offensive purposes occasionally crossed the minds of military men and inventors. A writer in the United Service Journal proposed something of the kind in 1833, and the Kaiser, that versatile genius, designed what he termed a "battle line destroyer" in 1897 which was to be as big as a Pullman sleeper, to be covered with steel plating and to bristle with guns and sharp prongs. So far as is known, this shore-going ironclad never reached the practical stage. The first year of the present century saw the first military motor to be really completed. This was a 16-horse-power car armed with a couple of machine guns, the car and its armament protected by rifle-proof steel shields. These gave the machine somewhat the appearance of the hull of a small man-of-war on wheels. It was the invention of Mr. Pennington, and a larger sized car carrying two six-pounders and a couple of machine guns was proposed as an improvement on his first design, but was not built. Two years later a car very similar in appearance to Pennington's first design was built to the order of Messrs. Vickers Sons & Maxim, by Mr. F. R. Sims, its inventor. It was a considerably bigger affair, being 10 feet high, 8 wide, and 28 long. It was completely covered with armor and carried a pair of "pompons" in revolving turrets. All its crew of five men were under cover. One, standing amidships, steered by aid of reflecting mirrors; one man in each turret worked the guns, extra ammunition being passed up by a man seated below. A war car of somewhat peculiar design was exhibited in Paris at the end of 1902. Generally it was much like an ordinary car with a pair of bucket seats, but behind these was fitted what looked like a traveling bath. As this was perched up pretty high the Hotchkiss machine gun which was mounted in it could be trained to any quarter of the horizon. The gunner got a certain amount of protection from the "bath" and the gun shield, but the chauffeur and any other passenger had to do without. The later types of war automobiles are all more or less of the closed cab type. The Daimler Company built a rather remarkable car for the Austrian government in 1905 at their works at Neustadt. It was completely covered with armor, had a revolving cupola at the top and both front and back wheels were directly driven by the motor, thus rendering it more than usually able to cope with the difficulties presented by rough or broken ground.

Russia is experimenting with a car built by Charron, Giradot & Co. at their Puteaux works. It is steel armored and provided with four-cylinder engines of 40 horse-power. Even the wheels have thin nickel-steel disks fastened to them. The car has a species of revolving turret at the top carrying a light gun and is provided with a set of steel rails of special construction in cases on either side, which can be used to bridge over anything very difficult in the way of a ditch or narrow stream that the car may come across.

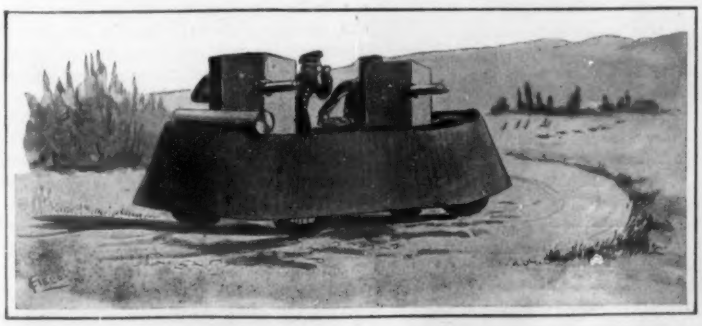
A Medieval War Car.

It may naturally be supposed that Germany does not hang behind in the provision of warlike novelties, and we find her making trial of two types of car. The one is hardly a fighting car in the ordinary sense of the word, as it is not provided with any offensive equipment. Nevertheless, it is armored so that the Kaiser—for whose special use it is designed—can, with some of his staff officers, brave the bullets of any of the enemy's scouts who may be in the neighborhood of his armies. Against artillery fire other than shrapnel neither this nor any other car yet built would afford any protection. The other war car is one built by the well-known firm of Erhardt. This is a more formidable affair carrying a quick-firing gun of 2½ inches caliber, which, mounted on a very high pedestal, can be fired over the driver's head. It is equipped with a four-cylinder 60-horse-power engine and covered with plating over an inch thick.

A 16th Century Conception of a Roman "Quadriga."

France, which has always been interested in the automobile, has recently produced two notable cars. The first is a 30-horse-power automobile with a Hotchkiss rapid-fire gun in its turret. The car, which weighs only 6,393 pounds, is completely armored with the exception of the tires, and the driver and gunner are protected. The turret is revolving, allowing the gun to point in any direction. The armor is about ¼ inch thick, and is practically impervious to rifle bullets. The latest is a 35-horse-power car, weighing 5,070 pounds and capable of traveling 28 miles an hour on good roads; though like all modern war cars it is specially designed for crossing rough country, and carries rails to bridge ditches.

So far, the modern war car has scarcely passed the experimental stage, but it is probable that before many years have passed the war automobile will be a recognized part of every civilized army.



Pennington's War Car, 1900.

A French War Car of 1902.

WAR CARS, ANCIENT AND MODERN.

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Amorphous Graphite as a Lubricant.

Although the excellence of graphite for all sorts of lubrication and its particular adaptability to certain difficult lubrication is a matter which is familiar, few, perhaps, are cognizant of the fact that there are two forms of graphite: flake, or foliated, and amorphous, or non-structural, graphite; and that though chemically the same, the latter is capable of finer pulverization and with careful treatment may be reduced to an impalpably fine powder absolutely free from grit or any sort of harmful impurity. Flake graphite, on the other hand, no matter how finely pulverized, always retains its original mica-like or crystalline structure and, comparing one with the other, there is a vast difference in nature, texture, action, and effect.

In the first place, amorphous graphite is adhesive in the highest degree. It stays put, and adhesiveness is one of the first requisites of an efficient lubricant in that to cool a hot bearing it is absolutely essential that the lubricating agent "stay put" where applied. To illustrate: Take a pinch of finely pulverized amorphous graphite and rub same in the palm of the hand, on paper, or on some other convenient surface, and observe its action. Note that the more one rubs the more effective the lubrication, for this form of graphite is not easily removed from surfaces in frictional contact, but maintains constant and effective duty right at the point of contact and is at its best under heavy frictional pressure in that as above stated it is adhesive in the highest degree—"stays put"; there is absolutely no waste, as every particle is an active lubricating factor. Then, too, as an impalpable powder it readily and quickly penetrates and distributes itself in a smooth, slippery, even coating between the tightest bearings, filling every pore, crevice, and interstice, thereby evening irregular bearing surfaces and reducing friction to a minimum.

Let us also see how, mixed with lubricating oils, this amorphous graphite will minimize friction. A microscopic examination of perfectly smooth bearings, cylinder surfaces for instance, will disclose many minute irregularities, which, in the nature of things, must be productive of more or less friction. This friction of course means wasted energy, energy that instead of being utilized as power is absorbed as heat, a condition that more often than not means an overheated bearing with the consequent loss of time and temper. To effectively overcome this friction and utilize this otherwise wasted power, a lubricant possessing considerable "body" is required—it must be a substantial lubricant of such a nature as to eliminate as far as possible these microscopical irregularities and provide a bearing offering minimum resistance to the surfaces in play.

Experience, which is man's teacher, has not only demonstrated time and again that oil in itself will accomplish this only to a certain extent, but it has also taught that pure soft finely-powdered graphite, properly and judiciously applied, will do wonders, so it only remains to make the proper application of the right sort of graphite. It has, therefore, long been the endeavor of intelligent engineers to secure a graphited oil, that is to say, an oil in which graphite floats or is held in suspension without precipitation sufficiently

long to perform its duty, for it is easy to see the great advantage to be derived from the use of an oil having every drop impregnated with solid lubricating matter.

This seemingly simple problem, however, is one that has until lately baffled engineers of experience, but it has now been found that amorphous graphite when reduced to an impalpably fine powder, when mixed with oil in the proportion of about one teaspoonful to the pint of oil, will remain in perfect suspension long enough to feed through lubricator tubes without clogging, thus causing every drop of oil to carry its mite of graphite.—The Railway and Engineering Review.

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BLOOD PRESSURE AND MENTAL CONDITIONS.

In addition to those bodily movements which are called "voluntary," various bodily phenomena which are clearly involuntary accompany violent mental excitement. The blush of shame, the distinctive flushes of joy and of anger, the pallor and sweat of fear, the tears of grief, and the "creeping" of the flesh provoked by horror, are familiar examples. The respiration is quickened by joy, and retarded by anxiety, and the feeling of relief finds expression in a deep sigh. Violent emotions often disturb the digestion. The heart "bounds with joy," "is paralyzed by horror," "leaps to the throat" in terror. The connection between the heart and the emotions is so intimate that the heart was long regarded as the seat of the soul.

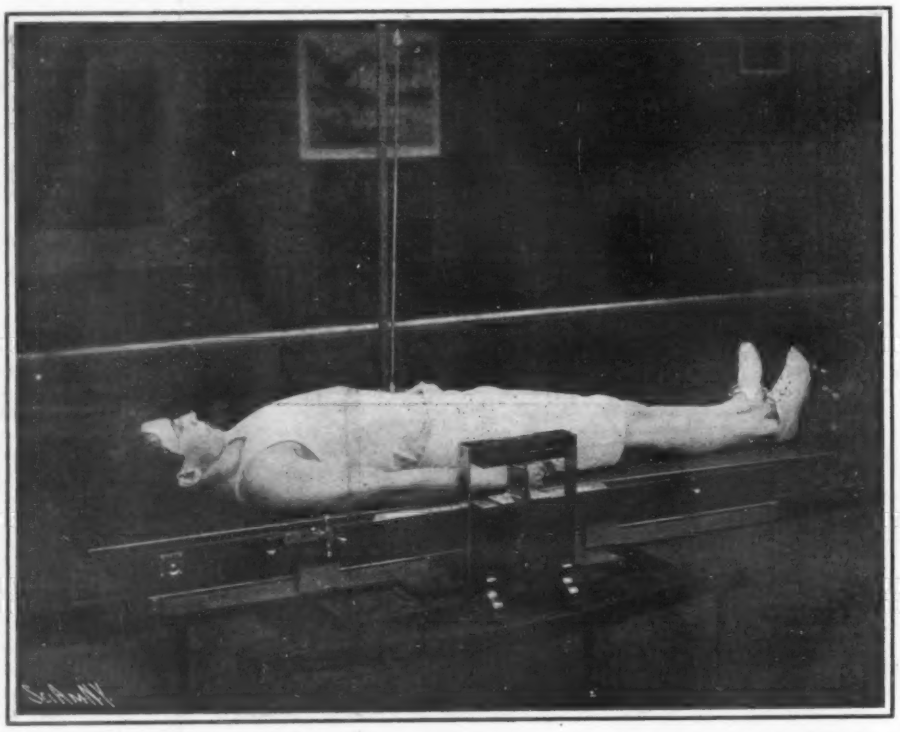
Most of these involuntary physical concomitants of mental excitement are brought about by a special part of the nervous system, the sympathetic nerve and its branches which ramify to every part of the body. The best known branches are those that govern the dilatation of the blood vessels, which are profoundly affected by mental states. These phenomena are susceptible of exact quantitative determination by means of a method devised by the Italian physiologist Mosso. The result is fairly accurate measurement of the variation of blood supply in the brain. The subject is laid on a board which is balanced on a fulcrum at the center of gravity in the manner illustrated in the accompanying engraving. When the subject is quiet and undisturbed the board lies horizontal. Now, if an unpleasant sensation or emotion is induced in the subject his head is involuntarily elevated, indicating diminution in the quantity of blood in the brain. An agreeable sensation or emotion produces the opposite effect.

In the course of the last twenty years, a great many experiments of this character have been made by many investigators, and have led to substantially identical results. The method of experiment should be adapted to the character of the subject. In many cases the feeling of pleasure can be aroused by offering a coin or other gift. At the moment of presentation the head-end of the board is tilted sharply down, indicating a sudden rush of blood. Then if the gift is taken away, with the explanation that it was presented in jest, the blood vessels contract and the head-end is elevated. Similar results are obtained by giving students favorable or unfavorable reports of examinations, reading poems to persons of fine sensibilities, etc.

There are great differences in the intensity of the physical effects of various mental processes. Difficult tasks in mental arithmetic, performed in private, cause only slight contraction of the blood vessels but the same calculations made in the presence of several persons, especially persons regarded with awe, cause great contraction. In general, emotional excitement, which common experience proves to be more fatiguing than purely intellectual activity, also affects the board more strongly.

Like many other modern discoveries these revelations are not absolutely new. Variations in the pulse were regarded in antiquity as indications of mental perturbation. Nearly 2,500 years ago Erasistratus, by feeling the pulse of the son of King Antiochus in the presence and in the absence of his young and charming stepmother, successfully diagnosed the young prince's puzzling malady as an "affection of the heart."

Severe bodily pain is commonly attended by alterations in the pulse and the pupil of the eye. This method of ascertaining whether a patient's suffering is as acute as he pretends was introduced by French physicians centuries ago.



BALANCED BOARD USED TO ASCERTAIN THE RELATION BETWEEN BLOOD PRESSURE AND PSYCHICAL CONDITIONS.

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The Lost Continent in the South Seas.

The contention that Fiji and contiguous islands are remnants of a lost continent is supported by the investigations of Dr. Woolnough, of the Sydney University. Recently he spent several weeks in Fiji, when he directed special attention to the occurrence of granite recorded by Kleinschmidt some years ago. The main difficulty in the way of reconciling existing conditions with an original great area was that depths of 2,000 fathoms occur between the islands under notice. The Solomons and other islets were undoubtedly the visible links in the chain which ended at New Guinea. But against this theory had to be placed the immense volcanic and coral areas of Fiji, which were of more recent origin than the rocks forming the basic fabric of the continental area. It was necessary, therefore, to look for land evidences of faulting or breaking to account for the submarine depths. The granite area in Viti Leva was found to be from 400 to 600 square miles in extent, underlying the modern volcanic rocks. He was, however, unable to determine the relationship between the granites and slates, although he traced the lines of junction to some extent. A range of granite mountains with precipitous cliffs on each side gave evidence of heavy faults, creating chasms of great depths. He found the rivers forming a marked rectangular network, an upraised coral reef 200 feet above sea level, conglomerate rock showing sea-shells at a height of 800 feet above the sea, certain earth tilts and tuffs which had formerly been submarine and were now at a height of 4,500 feet. All these indicated a tremendous uplift, sufficient to cause greater faulting in the original continent. The rivers of Fiji were of comparatively youthful development, and even at present passing through their cañon cycle. Many beautiful examples of hanging valleys were observed.

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The Scientific American Trophy.

The Scientific American Trophy is now on exhibition in the window of Messrs. Reed & Barton, 32d Street and Fifth Avenue, New York. It is attracting much attention. It will be competed for at St. Louis October 22, 1907.

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Change in the Time of Allowance of United States Patents.

As most inventors know, it has hitherto been the practice of the United States Patent Office to issue patents on inventions three weeks after the date of allowance on payment of the final government fee. The Commissioner of Patents has given instructions that hereafter the period between the date of allowance and the issue of the patent shall be four weeks.

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Farmers have always considered that hogs should be turned loose in an orchard. By picking up the windfalls they destroy many insects, whose presence is often the cause of the fall. It is stated on good authority that they are very destructive to the larvæ and pupæ of the codling moth, and will grow fat in an infested district.

A UNIVERSAL ASTRONOMICAL CLOCK.

BY DR. ALFRED GRADENWITZ.

The astronomical clock which is illustrated herewith is a most marvelous example of horological and mechanical skill. It was designed and constructed by Christian Reithmann, astronomer and scientific mechanician, at Munich, and involved four years of work (not including two years of preparatory calculation; the mathematical rate calculations were worked out to from six to ten decimal places, in order to dispense with any future readjustment of the works). It is intended for the tower of the new Munich town-hall, and pending the completion of this building has been exhibited at the German Museum of that city.

This clock, the decorative part of which was executed by Prof. Otto Hupp, has the form of a three-tower structure, and is fitted with thirteen artistic dials. The lower part of the construction, in front of which there is a projecting balustrade, together with the planetarium, is made of stained wood, and the middle and upper parts of ornamental gilded copper. An enormous number of wheels was required to perform the manifold functions of the clock, the planetarium alone comprising no less than 400 wheels with an aggregate number of 20,000 teeth, in order to represent with astronomical accuracy the revolution round the sun of the eight main planets and their satellites.

The central dial of the clock consists of twelve parts. Two of the hands will indicate the local time of Munich, and a third the mean European time. Adjoining this central panel is a *polytopical clock*, comprising a twenty-four-hour ring, the hours of the day being marked in white, and those of the night in black figures. On another ring surrounding the whole there are marked in artistically arranged panels the names of the eighty principal cities of the world. Each of these panels is provided with a golden arrow pointing toward a given part of the ring, which bears the Roman figures, thus allowing the local time of the city in question to be read at any moment. All of the dials and hands are real masterpieces of art.

The main dial to the left of the polytopical clock is the *astrolarium*, showing the actual position of the sun and moon among the constellations, as well as the right ascension, declination, and longitude of these bodies. The dial of the astrolarium comprises several movable rings, one of which gives the nodal position of the moon's orbit, the position of perigee and the distance of the moon. Whenever the sun and moon meet in one of the nodes of the lunar orbit, there is known to occur an eclipse of the sun; if, however, the moon at the same moment enters the earth's shadow, it will traverse the latter, producing an eclipse of the moon. The motions of the moon and sun are represented by Mr. Reithmann's mechanism with their characteristic irregularities, thus reproducing with absolute accuracy the relative positions of the two bodies, and the times of eclipses. On the inner part of the astrolarium dial there are shown the phases of the moon and seasons of the year, as well as the length of day and night for the actual date. A smaller dial on the left-hand tower will mark sidereal time, which is known to correspond to two successive passages of a fixed star through the meridian. This time is the most important to astronomers, allowing the *mean time* (according to which our clocks are adjusted and regulated) to be calculated.

The *calendarium* dial, to the right of the central dial, will indicate automatically the day of the week and the month, as well as leap days and leap years, while by means of an extensive mechanism the movable holidays are readjusted automatically, on the last day of December. The same dial further comprises two smaller dials, the apertures of which are opened more or less according as required for illustrating the duration of visibility of the sun and moon above our horizon. The rising and setting of these heavenly bodies are represented as well. The phases of the moon are likewise shown above a crowing cock (marking the hours) on the top of the middle tower. On the lateral tower of the clock, above the calendarium, there is marked *true solar time*, that is to say, the time given by sundials, and which corresponds to two successive passages of the sun through the meridian. A *movable stellar map* with the various constellations

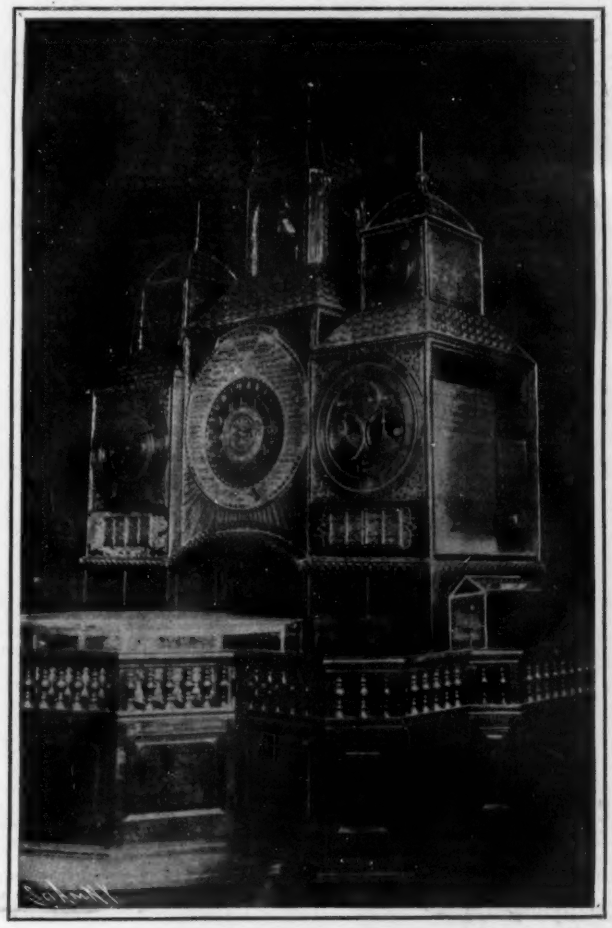
in high relief (indicating twelve hours in advance any constellations visible above the horizon of Munich) is installed on the side wall to the left of the casing. On both sides of this stellar map there are found enchased portraits of the most famous astronomers. The visible part of the astral sky with its constellations is represented on one of the upper panels on a smooth polished plate. A counterpart to this is a moon relief, showing the surface of the moon as visible through a telescope.

Below the stellar map there is situated the *lunar tellurium*, which represents the actual position of the earth and moon in relation to each other and to the sun. A molded solar system will be found on the left side wall of the case; and also statistics representing true conditions as regards the distances, forms, and positions of the planets. On a large *solar hemisphere* situated underneath are marked the ratios of magnitude of the sun and planets, on the scale of 1 meter to 1,000,000 (German) miles. In the left upper corner are given the data relating to the apparent diameters of the sun and planets, according to their distance from the earth. In a special compartment is located a *planetolabium*, illustrating the free axes of the planets and positions of the lunar orbits, as well as the resulting changes of seasons, origin of eclipses, etc.

One of the most interesting parts of the clock is the *planetarium*, which with far greater accuracy than any existing similar mechanical construction, will represent the various motions of the planets and satellites, illustrating with an extraordinary faithfulness the structure of our planetary system. On a tablet situated at the left of the planetarium there are given any necessary data as to the times of revolution of the planets, as well as their varying distances, and the orbit eccentricities of the positions of the planets mutually and in regard to the sun. The planetarium (which it took two and one-half years to complete) comprises elliptical orbits of non-uniform motion, which strictly correspond to nature. This part of the clock is shown from time to time at the German Museum with an accelerated motion (five seconds corresponding to one day), automatically reducing the bodies to the orbit corresponding to the actual time, thus allowing lay visitors to get some insight into the peculiar differences in the orbits traversed by a planet in a given time. Five driving gears are required to operate the above-mentioned astronomical mechanism, four of which are occupied by the calendarium, while the fifth will operate all the remaining dials and instruments inclusive of the planetarium. The shaft of the hour clock is the main shaft, and is designed for connection to an electrical or tower clock, disengaging the driving gear at intervals of a minute each.

The material value of the clock has been estimated by the constructor at about $15,000, while the ideal value of this masterpiece obviously is far greater.

The constructor of the clock is the son of another famous Munich mechanician and watchmaker, who, besides his inventions in the art of horology, is the inventor of the first four-cycle gas motor.



A UNIVERSAL ASTRONOMICAL CLOCK.

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GAS AND COKE FROM CRUDE OIL.

BY WILLIAM H. KNIGHT.

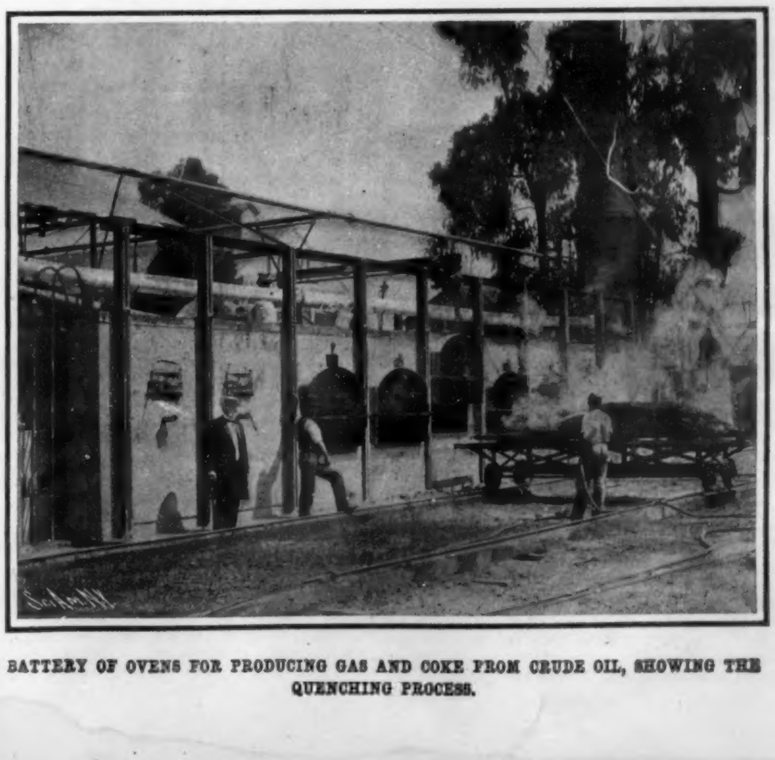
By a new chemical and mechanical process which has now reached a successful commercial stage, a perfect carbon coke may be derived from crude oil as a by-product, or perhaps we should say, as a co-product, in manufacturing an illuminating water gas from California mineral oil.

For some years Prof. Thaddeus S. C. Lowe, inventor of the illuminating water gas system, by which process about 80 per cent of the gas consumed in the United States and Canada is now manufactured, has been working to perfect a system of manufacturing gas from crude oil alone, which would show a satisfactory commercial efficiency. Under modifications of the old system approximating this result, the cities of Los Angeles, San Francisco, and other towns of California are now being furnished with gas made wholly or in part from crude oil. In manufacturing gas from crude oil alone, there is produced a large amount of lampblack and tar, which have no marketable value in this part of the country. It is to be noted that these materials are separated, in the Lowe process, in accordance with the chemical and physical laws governing the constitution and transformations of the crude oil, and are not due to any inherent imperfection in his gas-making system. The problem which Prof. Lowe undertook to solve, and which has engaged his attention for some years, was how to utilize the carbon in the lampblack, consisting of infinitely fine free particles, and in the tar which retained much of the useful gaseous elements. He proceeded to mix the lampblack and the tar in various proportions, until at length, upon placing this mixture in the reverberating ovens and subjecting it to a very high temperature, a large additional amount of gas was evolved and carried as before to the gasholder. But here a result was produced that was unexpected; the residuum was changed into an entirely new substance. In short, it was a true coke, of the highest grade, firm, hard, dense, of a silvery color—an ideal coke—with not more than a trace of sulphur or other impurities usually found in the article produced from coking coal.

The coking plant constructed by Prof. Lowe consists of a series of reverberating ovens connected with each other by flues arranged in a special manner, and connected at each end of the series with heating and superheating chambers of special design, and having boilers and stacks at both ends, the boilers being operated by the waste heat from the ovens. As the battery of ovens has superheaters, stacks, and boilers at either end, the operator is enabled to work it first in one direction and then in the other, thus enhancing the efficiency and capacity of the apparatus, as the reverse blast is heated by the waste heat of the superheaters. The oil, injected into these ovens as a fine spray, soon reaches a temperature so high that the hydrocarbons of which it is composed are dissociated, and the resulting permanent gases are forced through the so-called washers (specially constructed tanks filled with water). Here the precipitated carbon is deposited in the form of lampblack, which is used in making some kinds of ink and is also the basis of certain lubricating compounds. The gases are then carried through the scrubber (a large vertical cylinder containing several chambers), which serves to eliminate all the tarry substances. These substances also have various uses, being a basis for the manufacture of the beautiful aniline dyes and other so-called "coal-tar products." The gas then passes through the condenser and the purifier, finally reaching the holder, whence it is pumped into the mains and distributed throughout the city under a uniform pressure.

But Prof. Lowe's experiments went further. He received a carload of slack non-coking coal from Tennessee and piled several sacks of it into one of his ovens, and subjected it to the high temperature his system produces. The slack coal was melted into a pasty compound, dissolved, vaporized, and its dissociated gases were carried forward as in the case of the crude oil, leaving a rich residuum in the ovens as before. This yielded a coke scarcely inferior to that derived from the best coking coal. It was evident that this process had opened up possibilities of new applications of the mechanical arts, and new and larger fields of utility in the industrial world.

One of the iron foundries in Los Angeles which uses Connellsville coke, recently made a melting of 5,500 pounds of iron with 700 pounds of the Lowe metallurgical coke, the melting stage being reached in 9 minutes, as against 13 to 15 minutes for eastern coke in the same cupola. At the end of the melting there was no slag, but considerable of the coke was left, and used again the next day.



BATTERY OF OVENS FOR PRODUCING GAS AND COKE FROM CRUDE OIL, SHOWING THE QUENCHING PROCESS.

◆◆◆

Municipal Motor Cars.

Consul Halstead reports that in Birmingham, England, the tramway, water, electricity, and fire departments have already adopted motor cars, and the results are reported to be satisfactory. Every car used is of British construction. The tramway department has a car that has been used for two and a half years, which is employed for inspection purposes. Another car is used for the purpose of collecting tramway receipts from the various depots. This car has also a large platform space so that it can be used for delivering stores. There is, further, a motor tower wagon for inspection and repair of overhead wires and another wagon for general maintenance of overhead equipment. As Birmingham's water is brought 75 miles from Wales, it has been found desirable for the municipality to employ two motor cars for inspection purposes. The electricity department employs two motor cars for inspection purposes as well as for visiting prospective consumers of electricity. The fire department has two large cars which are sent ahead of the engines at the time of a fire in order to prepare for their coming. It is likely that later on Birmingham will follow the example of several other English municipalities and adopt motor fire engines.

◆

The cars which will run through the new tunnels connecting Manhattan with Long Island will have doors on the sides, thus insuring quick loading and unloading.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SKIRT-HOLDER.—F. H. NEWTON, Greenville, S. C. The invention contemplates the employment of a cord or chain, the body of which is normally wound upon a reel within the case which is pinned upon the skirt at the upper portion thereof, and one of the objects is to provide means for clamping this cord or chain to limit the same against further extension.

BELT-BUCKLE.—J. D. TEMPLETON, Ada, Ohio. The object of the improvement is to provide details of construction for a buckle for waist belts, suspenders or the like, which afford a neat, simple, practical, and inexpensive device. The coaction of the bent and pivoted head portion of the hook piece with the buckle frame having the inclined teeth, are the dominant features.

HAT-FASTENER.—M. E. JENNINGS and A. J. WINEBRAKE, Scranton, Pa. By this invention it is intended to provide in connection with hat-pins, a holder therefor which will be self-retaining in the hat, will be adjustable to fit any size or shape of crown, and will be provided with a bushing or sleeve through which the pins slide to avoid wear of the hat material, and also to steady the pins in position.

Of Interest to Farmers.

PLANTER.—E. B. WINSHIP, Rushville, Ind. One of the objects of this invention is to provide a simple, strong, and efficient planter having a frame provided with drill teeth and supported upon a wheel, and having means for automatically elevating the frame at predetermined intervals in order to free the drill teeth from weeds and the like.

HAY RAKE AND TEDDER.—K. M. ELLIS and E. E. ELLIS, Greeley, Iowa. The purpose of the invention is to provide a construction by means of which the hay is raked to the right-hand side of the implement and left in a windrow, and the tedders automatically act upon the windrowed hay and move it over to the right, leaving the hay in a most convenient position for the loader, enabling a loader to take up the hay without looping back over a portion of the ground that the rake has already covered.

Of General Interest.

ANIMAL-TRAP.—H. TURNER, Richmond, Va. The object of the invention is to furnish a device adapted to be placed over the hole in the floor or ground through which the animal makes its entrance, and whereby the animal may be captured, or if not, prevented from entering the room. The device is likewise adapted to be placed against the wall and surround an opening therein in the same manner as when used in connection with a hole in the floor or ground.

SHAVING-BRUSH AND SOAP-HOLDER.—M. SCHMITZ, Schenectady, N. Y. This brush and holder is more especially designed for travelers' use, and is arranged to utilize the handle of the brush as a casing for the holder carrying the soap stick, and to allow of projecting the soap stick the desired distance beyond the handle for rubbing the stick over the face to be lathered.

Hardware.

WRENCH.—E. H. BOAZ, Benbrook, Texas. The object of the improvement is the provision of a wrench arranged to combine simplicity with strength to permit convenient gripping, turning, and releasing of different sized nuts or other articles, and to allow of screwing the nut any distance along a bolt without removing the wrench from the nut.

MAIL-BAG LOCK.—R. E. REDDING, Marion, Ala. The intention in this improvement is to provide a lock having novel features of construction, which adapt it for a locked engagement with a constricting strap passed closely around the closed neck of a mail bag or pouch, and thus prevent access to the contents of the receptacle until the lock is opened with a suitable key.

Household Utilities.

LARDING-NEEDLE FOR MEAT.—P. HUSS, Lakewood, N. J. This invention comprises a tapered tubular body to receive a larding strip, and a removable tapered tip constituting a plug for the forward end of the body, the butt end of the latter being open whereby the end of the strip may project and be withdrawn when the needle is forced through the meat.

CLOTHES-LINE HOLDER.—H. FALVEY, New York, N. Y. The aim of this improvement is to provide a line holder comprising a trough-shaped sheet-metal arm having a sheave journaled in a trough of the arm near each end thereof, and means for pivotally attaching to the arm intermediate sheaves whereby it is adapted to swing in a substantially vertical plane.

BED.—H. F. NEHR, New York, N. Y. One of the purposes of the invention is to provide a divisional bed or a bed the spring-sustaining portion whereof is in two sections removably mounted and capable of being brought together to form a double bed, or separated to constitute two single beds with a space between them, thus rendering the bed sanitary.

DUST-REMOVING APPARATUS.—H. BOGENSCHILD, Berlin, Germany. In this patent the invention relates to brushing and scrubbing, and its object is to provide a new and improved dust-removing apparatus for use in domestic and industrial purposes, such as cleaning carpets, upholstered furniture, tapestries, hangings, curtains, walls, wall papers, printing types and fonts, etc.

Machines and Mechanical Devices.

HOP-PRESS.—C. KUENSTING, Woodburn, Ore. This press is designed especially for the baling of hops, but applicable also to other uses. The invention provides a press which is easily portable, conveniently loaded, of simple construction, without large metal castings, and of a graduated power apportioned to the increased compression strain as the follower compresses the bale.

POWER TRANSMISSION.—D. M. LE BARON, Amos, Nevada. In this instance the invention refers to wind motors, and its object is to provide a power transmission, more especially designed for use on wind mills, and arranged to utilize the power of the wind mill for pumping water in both light and strong winds.

GEARING.—J. J. P. BOATMAN, Blaine, Wash. An improved cone is provided in this system of gearing. It is easy to adjust the cone on a shaft to compensate for wear. A collar is provided with a setscrew whereby it may be fixed with respect to the shaft, is connected to the smaller disk by means of screw threaded rods, secured to the disk, and traversing openings in the collar. Lock nuts are arranged upon a screw threaded rod upon each side of the collar, whereby to secure the cone in its adjusted position. When the cone becomes worn the nut locks are loosened and the cone is adjusted, after which the lock nuts are again tightened.

Pertaining to Vehicles.

SPROCKET-CHAIN.—R. S. MCINTYRE, Riverside, Cal. The present specification is a division of the original one claiming this invention, formerly filed by Mr. McIntyre. The object is to produce a chain constructed with a special view to preventing its becoming dislodged from the sprocket wheels over which it runs, without in any way detracting from the efficiency of the chain in operation.

Railways and Their Accessories.

RAIL-JOINT.—L. A. BUNDY, Atlanta, Kan. The direction of the present invention is to improvements in rail joints, preferably embodying features of construction of a rail joint for which Letters Patent were formerly granted to Mr. Bundy. Among the objects is the provision of a rail connection that will insure a smooth road with no low joints, and in which the joints will be held against any accidental lateral displacement.

MAIL-BAG CATCHER AND DELIVERER.—A. D. WALTON and C. H. ANTHONY, St. James, Mo. The device is such as used for passing the mail bags to and from express trains as they pass post-offices located on the railway line. Two bags can be hung upon the holder at once and can be as readily caught or delivered as one bag. The fact that both catchers are reversible, enables them to operate with trains passing in either direction.

AUTOMATIC SAFETY APPARATUS FOR RAILWAYS.—G. E. RYAN, New York, N. Y. The use of automatically-operated track devices which are set by trains as they pass, is sought by this inventor. In this way each train as it proceeds maintains a track device in a set position at a suitable distance in its rear. A following train cannot pass this track without having its power automatically cut off. In this way rear-end collisions are prevented.

Pertaining to Recreation.

GAME-BOARD.—O. FALKENBERG, Baltimore, Md. The object of the invention is to produce a game board for playing a parlor game which will afford amusement and instruction to the players. The game involves the use of a map upon which routes of travel are indicated and involves also the element of chance, brought in by the use of dice.

Designs.

DESIGN FOR AN ORNAMENT.—J. W. TALBOT, South Bend, Ind. This ornamental design is embodied in the figures of three owls, perched upon a branch and facing to the front, each bird bearing the letter O upon its breast.

DESIGN FOR A CLOCK-STAND.—W. T. HOPSON, New London, Conn. The design embodies a circle around the face of the clock, with the lower part spreading at the base and terminating in feet. The entire exquisite ornamental effect is produced by scroll patterns which surround the dial frame and inclose two cupids suspended under the frame.

DESIGN FOR A DOLL.—S. KAHN and W. REISENSTEIN, New York, N. Y. The design in this case shows a doll dressed in fur or like material from the top of the head to the feet. A hood tied under the chin gives the doll a complete Esquimau garment or outfit.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(10625) A. C. asks: What size lens would be required to melt gold by focusing the sun's rays, if the focus would be ¼ inch in diameter? A. A mathematical answer to the question could not be made, unless all the conditions could be definitely assigned. The altitude of the sun above the horizon at the time is the most important of these, while the optical condition of the atmosphere is a close second. The amount of carbon dioxide in the air of the place, it has recently been determined, exercises a very powerful absorptive influence upon the heating value of the solar rays. On the other hand, the temperature to be reached by a metal depends upon the ratio of its absorbing and radiating power, and the time during which the heat is applied. In the open air a substance might be able to radiate heat so rapidly as not to melt at all, but would maintain a constant temperature, radiating as much heat as it received. If a mathematical calculation is to be made, it may be based upon the accepted assumption that the vertical sun is able to melt an inch of ice (more accurately, 24.7 millimeters) in an hour. The calculation may also be made from the statement that 3 horse-power is received on every square yard exposed to the vertical rays of the sun. We are not able to say what the diameter of the smallest lens is, which is capable of producing a temperature equal to that of the melting point of gold, or a temperature of 1,080 deg. C., equal to 1,976 deg. F., but Ganot's "Physics" contains the statement that a plano-convex echelon lens, 2 feet in diameter, has melted gold, platinum, and quartz. This would indicate a temperature nearly or quite equal to that of the electric arc, from 6,300 to 7,000 deg. F., if quartz was actually melted by it. If we wished to solve this question we should take a lens of this size and reduce its opening by diaphragms until the smallest opening was found at which gold would melt.

(10626) J. F. K. asks: Will you kindly give me the following information or tell me where I can get it? 1. Roughly speaking, what is the combined mileage of the different railroads in the United States, not counting the switches, side tracks, etc.? A. The combined main track mileage of the railroads of the United States is 218,018 miles. 2. What is the average distance the ties for same are supposed to be placed apart? A. The ties are placed at an average distance apart of 24 inches (between centers). 3. What is the approximate cost of the wooden ties now in use? A. Wooden ties have approximately doubled in cost in the last decade, and the cost varies greatly with the quality, which of course for railroad purposes means durability. A tie with a life of five years may be said to cost in round figures a dollar, and preservative treatment with the addition of tie-plates and the substitution of bolts for spikes may bring its cost up to $1.65, but the life of the tie so treated may be approximately tripled, thus effecting a saving of 7 or 8 cents per annum per tie. 4. What is the average cost of the metal ties that have been used up to the present time? A. The metal ties used in this country cost from $2.50 to $3.25, the principal railroads experimenting with them from 1889 to 1899 reported emphatically against them, and the general railroad practice in this country goes to show that better results can be obtained by the preservative treatment of wooden ties. In Europe, where less wide distribution of population gives greater proportionate funds for attention to permanent way, the use of steel ties is constantly increasing, and the best opinion and experience go to show that the use of well-made steel ties properly laid (not in marshy ground or badly drained roadbed) will effect a great saving in renewal and maintenance labor, the ties having a life of thirty years and upward. We have no figures as to the number of steel ties in use here; you might obtain the information by writing to the United States Forestry Division, which has made a study of the question with reference to forest depletion by the use of wooden ties.

(10627) C. A. E. writes: We would like to inquire if common black gas pipe could be coated with a babbitt metal in such a way as to withstand copper and sulphur water in a mine or other places where it would come in contact with same. We would like to prepare some pipe and dip in a preparation that would ahere to the pipe inside and out, so as to make same more serviceable in a mine. We have enameled same, but find it is too easily chipped off. Galvanizing does not protect much better than ordinary black pipe. A. There are various acid-proof paints of which you can obtain particulars by writing to any paint and enamel dealer, but we doubt if you will find any of them better than asphaltum. The latter should be of such quality as to be fairly elastic when cold, softening but little at 100 degrees Fahrenheit, and should be heated to about 350 degrees before the pipe is dipped into it. The pipe should be warm and *thoroughly dry*.

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THE TABLE TELLS THE STORY

A Comparison of Non-Participating Premium Rates Between

The Prudential

and

The Average Rates of One Hundred and Two Other Life Insurance Companies of the World.

The Premium Rates

on The Prudential's

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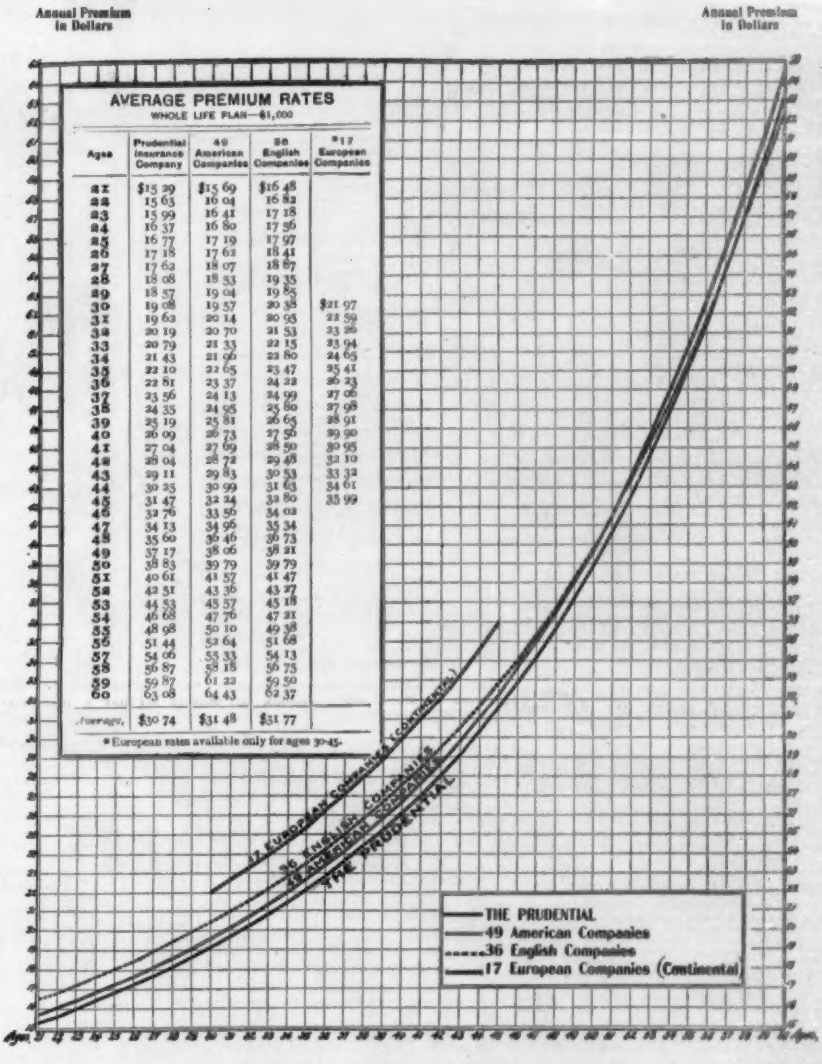

AVERAGE PREMIUM RATES
WHOLE LIFE PLAN—$1,000

Ages	Prudential Insurance Company	49 American Companies	36 English Companies	*17 European Companies
21	$15 29	$15 69	$16 48	
22	15 63	16 04	16 82	
23	15 99	16 41	17 18	
24	16 37	16 80	17 56	
25	16 77	17 19	17 97	
26	17 18	17 62	18 41	
27	17 62	18 07	18 87	
28	18 08	18 53	19 35	
29	18 57	19 04	19 85	
30	19 08	19 57	20 38	$21 97
31	19 62	20 14	20 95	22 59
32	20 19	20 70	21 53	23 26
33	20 79	21 33	22 15	23 94
34	21 43	21 96	22 80	24 65
35	22 10	22 65	23 47	25 41
36	22 81	23 37	24 22	26 23
37	23 56	24 13	24 99	27 06
38	24 35	24 95	25 80	27 98
39	25 19	25 81	26 65	28 91
40	26 09	26 73	27 56	29 90
41	27 04	27 69	28 50	30 95
42	28 04	28 72	29 48	32 10
43	29 11	29 83	30 53	33 32
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47	34 13	34 96	35 34	
48	35 60	36 46	36 73	
49	37 17	38 06	38 21	
50	38 83	39 79	39 79	
51	40 61	41 57	41 47	
52	42 51	43 36	43 27	
53	44 53	45 57	45 18	
54	46 68	47 76	47 21	
55	48 98	50 10	49 38	
56	51 44	52 64	51 68	
57	54 06	55 33	54 13	
58	56 87	58 18	56 75	
59	59 87	61 22	59 50	
60	63 08	64 43	62 37	
Average,	$30 74	$31 48	$31 77	

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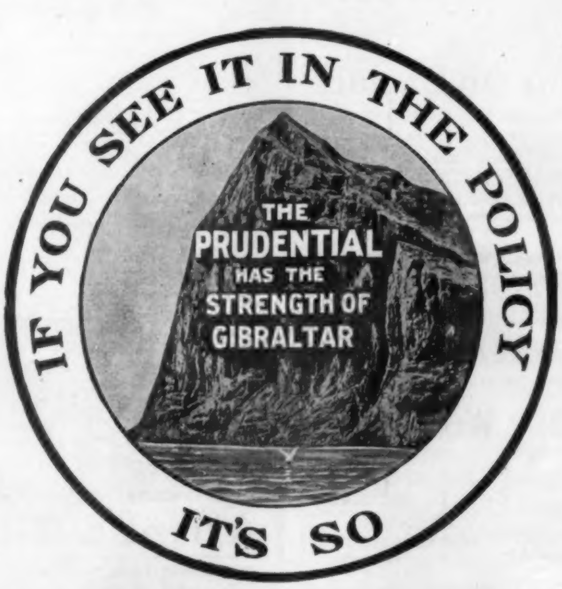

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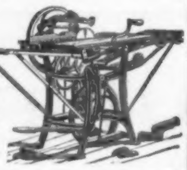

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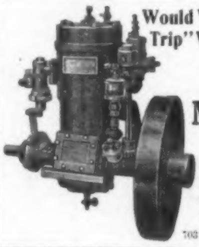

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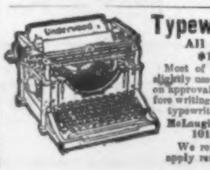

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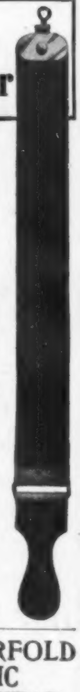

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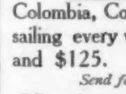

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Soap holder and grater, J. J. Lee	867,386
Solder-hemmed cap, E. M. Lang, Jr	867,383
Solder, manufactured, E. M. Lang, Jr	867,384
Spike, R. E. L. Simmerman	867,429
Spinning machine, mule, W. E. Ahern	867,332
Spring-platform for vehicle-seats, chairs, lounges, and bed-bottoms, H. Higgin	867,507
Square, folding steel, J. Roop	867,420
Stacker, hay, J. Dain	867,248
Starch powder, laundry, J. Benold	876,235
Steam engine, F. H. Mills	867,394
Steering gear, M. A. McEntire	867,290
Stoker, mechanical, M. Swintek	867,443
Surgical appliance, R. C. Barrie	867,340
Sweeping compound, B. Singer	867,538
Syringe, J. H. Thayer	867,445
Syringe, vaginal, W. G. Cronkright	867,247
Talking machine sound-box, J. H. Elfering	867,259
Tallying sheet, M. H. Watson	867,325
Tapping die, G. Ermold	867,262
Telephone lines, testing system for, W. W. Dean	867,349
Thill coupling, H. M. Reynolds	867,413
Thread retainer, A. N. Chartier	867,347
Tire-protecting device, L. H. Kinnard	867,515
Tires, etc., device for inflating, R. H. Campbell	867,474
Tires to wheel rims, means for fastening, Bradford & Holden	867,552
Tool, combination, R. Campbell	867,556
Top, E. A. Hoen	867,373
Toy, J. K. Allen	867,226
Track sander, J. M. Smith	867,434
Traction apparatus, electric, A. Zehden, reissue	12,700
Traction-operated implements, attachment for, Helvig & Danielson	867,368
Trains, automatic safety controlling means for, D. S. Affleck	867,331
Tramway, aerial, Gemmer & Schleicher	867,497
Tramways and the like, point shifter for, G. D. A. Parr	867,528
Tub. See Bath-tub.	
Tunneling, D. Maxwell	867,392
Tunneling apparatus, D. Maxwell	867,284, 867,520
Turbine adapted for the use of combustible gases at very high temperatures, C. Rollin	867,419
Turbine wheel, J. F. M. Patitz	867,407
Type-casting machine, F. A. Johnson	867,277
Typewriter tabulating device, G. W. Campbell	867,243
Umbrella, A. H. Bamberger	867,227
Umbrella and walking stick attachment, R. J. Newson	807,403
Valuable case, collapsible, J. E. Carroll	867,558
Valve, A. F. Blesch	867,341
Valve, C. F. Obrecht	807,405
Valve, check, Confer & Woodling	867,245
Valve, check, A. J. Pfluger	867,299
Valve for liquid fuel burners, regulating, C. F. Currey	867,560
Valve mechanism, E. H. Holmes	867,273
Valve, plug, M. J. McGill	867,399
Valve, pressure-equalizing, C. W. Henson	867,370
Valve, water cooled, N. McConnell	867,289
Vat cover, bleach and dye, F. R. Vose	867,453
Vehicle, side spring, C. A. Behlen	867,233
Vehicle step, W. A. Lannom	867,385
Vehicles, propulsion of, C. P. Delo	867,254
Vending machine, I. C. Woodward	867,545
Wagon bed and rack, combination, J. I. Sharp	867,300
Wagon brake, L. C. Leopold	867,387
Wagon, dumping, J. Heberling	867,366
Washing machine stand, G. W. Froelich	867,493
Water elevator, pneumatic, Bourne & Stevens	867,470
Water heater, W. P. Cosper	867,480
Water, treating, A. J. Simmons	867,313
Weighing machine, automatic, Douglass & Jones	867,354
Well-making machine, M. D. & R. T. Rochford	867,536
Wheel brace, Z. M. Bonner	867,237
Winding machine, W. C. Perry	867,298
Window, casement, I. Wroblewski, reissue	12,699
Window frame, metallic, W. J. Henry	867,360
Wire molding receptacle, three, J. S. Stewart	867,440
Wires and the like, apparatus for straining, C. Burton	867,241
Wrench, C. T. Holman	867,272
Wrench, G. P. Weichel	867,326
Wrench, R. Toward	867,450
Wrench, M. H. Hartman	867,504

DESIGNS.

Bedstead, E. de Wolfe	38,843

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"Banzai Pongee Handkerchiefs," for handkerchiefs, Bacon Art Co.	13,816
"Buffalo Mead," for a carbonated beverage, T. Brazell	13,811
"Fine Rollmops," for fish prepared for the market, S. Schmidt & Co.	13,812
"H & L Sanitas Soft Finish Gentlemen's Handkerchiefs," for handkerchiefs, Bacon Art Co.	13,817
"Hydrona," for a complexion powder, A. W. Leaman	13,813
"Nedra," for tea, Arbuckle Brothers	13,810
"Silkella Handkerchiefs," for handkerchiefs, Bacon Art Co.	13,815
"U-Auto Polish," for a polish for automobiles and carriages, Shove & Gage Co.	13,814

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"Apparel for Man and Boy," for clothing, E. L. Boone	2,124
"Eventually," for flour, Washburn-Crosby Co.	2,123
"Men's Apparel," for men's apparel, Schloss Bros. & Co.	2,125
"Wear Edesco Clothes," for men's clothing, H. E. Strauss & Co.	2,126

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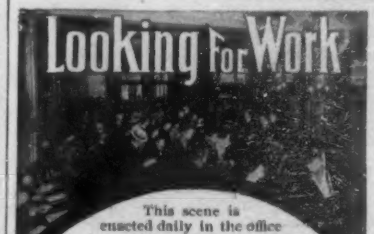

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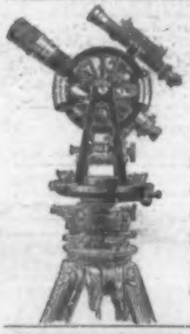

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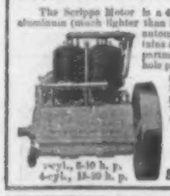

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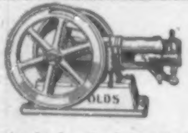

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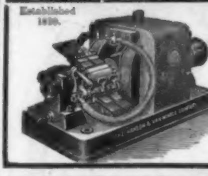

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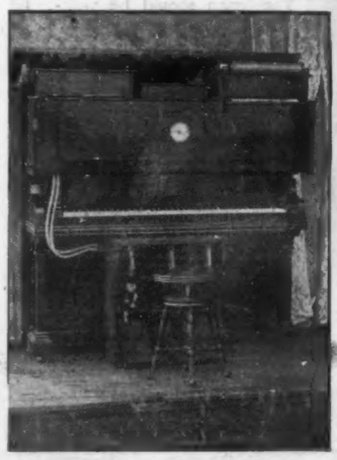

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